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The genera of diaspinae of North America and the genus lepidosaphes

John N. Summers
University of Massachusetts - Amherst

THE GENERA OF DIASPINAE OF NORTH AMERICA

AND THE GENUS LEPIDOSAPHES.

John N. Summers, B. S.

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Introduction

The following paper comprising a contribution to our knowledge of the subfamily Diaspinae of the family Coccidae has been prepared with the view of eliminating a few of the many difficulties one experiences in the classification of insects belonging to this interesting group.

Work on the family Coccidae was first begun by the writer during the winter of 1907- 08. The scale insect collection of the Massachusetts Agricultural Experiment Station is a large one, and at that time contained much unworked material, the working up of which fell to the writer as assistant in the Department of Entomology.

During the work of classification it became more and more evident that accurate tables for the separation of the different genera and species known to North America were badly needed, and this paper is an attempt to satisfy this need.

The family Coccidae has long claimed the attention of systematic entomologists, but the main endeavor has been to describe the species discovered, and very little effort has been made to prepare tables for their separation. With the large number of insects described, the descriptions of which have been published in a vast number of different entomological papers, a large amount of time is wasted in reading over descriptions when one desires to classify

a specimen.

It would be rather difficult to estimate the amount of time spent on the preparation of this paper, as in a way the classification of the unworked material in our collection gave me the preliminary training which is the most important step in monographing a group. The actual writing of this contribution which serves as the major portion of a thesis for the degree of Doctor of Philosophy, took about a year and a half.

I wish to express my appreciation of the great help and encouragement I have received from both Prof. C. H. Fernald and Dr. H. T. Fernald, and to acknowledge the great debt that I owe them for the many ways they have assisted me in the preparation of this paper. I also wish to express my gratitude to Mr. H. A. Ballou, whose kindness has enabled me to study many West Indian forms; to Drs. L. O. Howard and C. L. Marlatt through whom I was able to make a thorough study of many species not present in the Massachusetts collection, and to Prof. P. J. Parrott who kindly sent material in the genus Lepidosaphes.

The first step in the study of any insects belonging to the family Coccidae is the extraction of the color which conceals the important characters. This is best accomplished by boiling the specimens in a ten percent. solution of caustic potash; it is a distinct advantage to leave a small amount of the color to

bring out the minute details which are practically invisible in colorless specimens.

The length of time it is necessary to boil varies greatly according to the size of the insect dealt with and the length of time it has been dead, as the drying which results after death renders the color difficult to remove. Those insects belonging to the subfamily Diaspinae are easily prepared, but most of the others give considerable trouble. The insects in the Tachardinae must first be placed in strong alcohol to dissolve the wax with which they are covered before being boiled in the potash. With practically all of the others the best results are obtained by allowing them to stand in forty percent. potash for some time, taking care to make a few holes in the insects with a needle, as soon as they become soft so as to allow the potash to enter and attack the color of the internal structure; this long soaking will in most cases remove practically all of the color, but occasionally it is necessary to boil for a short time.

The most convenient receptacle to boil the insects in is a small, shallow, porcelain evaporating dish supported on a low tripod and heated by a small alcohol lamp; if possible the dish should be unglazed inside as it gives a less violent boiling, which is a thing to be avoided as there is danger of breaking the delicate insects, or of blowing them out of the dish by the

bursting of the bubbles.

For temporary mounts, which are most convenient when one desires simply to classify, the insects may be transferred directly to glycerine after boiling, but in case permanent mounts are desired, the usual method of procedure of working up through the alcolols to xylol and then into balsam is adopted.

HISTORICAL

While the family Coccidae has been the field for a large amount of work, so much of it was done in a disconnected way that at present many works no longer give as valuable aid, on account of the many changes that have been made since they were published.

Probably the most valuable works so far published on this family are the following: Signoret's Essai Sur les Cochenilles, published in the Annales de la Societe Entomologique de France, 1868--1876; Targioni-Tozzetti's Italian papers; Maskell's many papers published in the Transactions of the New Zealand Institute, and his Scale Insects of New Zealand; Newstead's Monograph of the British Coccidae; Green's The Coccidae of Ceylon; Comstock's first and second reports on scale insects printed in the Report of the Commissioner of Agriculture for the year 1880 and the Second Report of the Cornell Experiment Station; Mrs. Fernald's Catalogue of the Coccidae with the two papers by Sanders giving additions to the Catalogue; Ashmead's Generic Synopsis of the Coccidae and Cockerell's Tables for the Determination of the Genera of the Coccidae, besides many shorter papers.

In general, collectors have rather neglected this interesting family, so that outside of a few we have no collections that are what one might call large. Probably the largest collection in America is that owned by the United States National Museum at Washington, D. C. Other large collections are those of the Montana

Agricultural Experiment Station at Bozeman, Montana, and of the Massachuestts Agricultural Experiment Station, Amherst, Mass; besides these there are many collections in different sections of the United States, but none of them are large.

The chief criticism that can be advanced against the tables now in existence is that all of them have depended upon the male characters for at least a part of the separation. The male scales are small, are apt to be segregated, and for this reason are not always collected, and in many species they are hard to distinguish from immature females, so that the use of their characters in classification has proved very unsatisfactory. With the tables now available the only sure means of classifying is to become acquainted by extensive work, with the different forms, so that one would not need to resort to tables. The recently published descriptions of scale insects have as a whole been complete, the only thing lacking being a uniformity in the weight given to the importance of the various characters.

THE SUBFAMILY DIASPINAE

Signoret in his "Essai sur les Cochenilles" in the Annales de la Société Entomologique de France, 1869, p. 98, divided the family Coccidae into four sections, one of which was the Diaspides. Later Comstock in his Report on Scale Insects in the Report of the United States Commissioner of Agriculture for 1880 stated that each one of Signoret's sections should rank as a subfamily, and he therefore changed the name to Diaspinae.

The species under the Diaspinae are sharply separated from those of the other subfamilies by the distinguishing characters of the Diaspinae, but there is a certain relationship between this subfamily and the Conchaspinae that does not exist between it and the other subfamilies: in other words the two, Diaspinae and Conchaspinae are more closely related to each other than they are to any of the other subfamilies. To state the points of resemblance, both of the subfamilies in question have the insects protected by a more or less convex scale, which is entirely separate from the insect, though in some cases it may entirely enclose it, and the species of both have the last few segments of the abdomen fused to form a pygidium. There is no difficulty however, in separating the two, as the Diaspinae are characterized by the presence of exuviae in the scale and the absence of legs in the adult, while the Conchaspinae do not have exuviae in the scale and possess legs in the adult stage.

COCCIDAE

TABLE OF SUBFAMILIES.

1 (Adult female without legs, ... 2
(Adult female with legs, ... 3

2 (Insects covered by a scale formed partly of exuviae and partly of secretion, ... Diaspinae
(Insects covered by a waxy resinous secretion, ... Tachardinae

3 (Insects covered by a nearly flat scale-like covering composed entirely of secretion, ... Conchaspinae
(Insects covered or not, but if so not by a covering of the above type, ... 4

4 (Body cleft from posterior end to anal orifice, a pair of triangular plates above this orifice, ... Coccinae
(Body not cleft as above, no triangular plates, ... 5

5 (Insects without hairs on the anal ring, body not prolonged posteriorly into a long spur, not gall-like nor gall-forming, ... Monophlebinae
(Insects with one or more of the above characters, ... 6

6 (Adult female without mouth parts, ... Margarodinae
(Adult female with mouth parts present, ... 7

7 (Insects bearing numerous distinct flat felted plates of secretion, ... Orthezinae
(Insects bearing no such plates, ... 8

8 (Adult female with eyes consisting of a single ring of ocelli broken above and below, ... Phenacoleachiinae
(Adult female without eyes of the above type, ... Dactylopinae

Characters of the Diaspinae.

The subfamily Diaspinae may be separated from all others by the following characters. The insect is concealed by a scale-like covering composed partly of secretion and partly of exuviae. The adult female is without legs. The posterior end of the body of the adult female consists of a more or less triangular plate, the pygidium, which is composed of several abdominal segments fused together. This pygidium bears on its posterior edge various projections in the form of plates, lobes and spines; in it are situated the anal and genital openings, the dorsal tubular spinnerets, though these are not confined to the pygidium, and the circumgenital glands when present.

DIASPINAE.

TABLE OF GENERA.

1 (Insects living in galls on leaves, ... Cryptophyllaspis
1 (Insects not living in galls on leaves, ... 2

2 (Insects not covered by a distinct scale, being enveloped in a
2 (cottony secretion, ... Protodiaspis
2 (Insects covered by a distinct scale, ... 3

3 (Scale composed entirely of the second exuvia, no secretion
3 (being present, ... Gymnaspis
3 (Scale composed partly of exuviae and partly of secretion, ... 4

4 (Posterior edge of the pygidium with a row of fimbriated
4 (plates or blunt hairs, ... 5
4 (Posterior edge of pygidium without row of such plates or
4 (spines; at most a few between the lobes, ... 6

5 (Two exuviae on the scale, ... Parlatoria
5 (One exuvia on the scale, ... Leucaspis

6 (Exuviae occupying nearly all of the scale, amount of secretion
6 (small, ... 7
6 (Exuviae not occupying greater part of the scale, considerable
6 (secretion present, ... 8

7 (Scale very small, less than 1/2 mm. in length, ...Xanthophthalma
7 (Scale much larger, over 1/2 mm. in length, ... Fiorinia

8 (Scale circular or subcircular, ... 16
8 (Scale elongate, pointed at one end, ... 9

9 (Scale linear of same width throughout its length, ... 10
9 (Scale not linear, somewhat broadened posteriorly, ... 11

10 (Dorsum of the pygidium reticulated, ... Ischnaspis
10 (Dorsum of the pygidium not reticulated, ... Pseudischnaspis

11 (Circumgenital glands in more than five groups, ... Poliaspis
11 (Circumgenital glands not present in more than five groups, ... 12

12 (First pair of lobes with inner margins only free, ... Phenacaspis
12 (First pair of lobes with both margins free, ... 13

13 (Dorsal tubular spinnerets on the pygidium only present along
(the posterior margin, ... Pinnaspis
(Dorsal tubular spinnerets of the pygidium not confined to
(the margin, ... 14

14 (Ventral scale well developed, adheres to the dorsal scale
(enclosing the insect, so that both scale and insect are
(removed together, ... Lepidosaphes
(Ventral scale thinly developed, does not adhere to dorsal
(scale so as to enclose the insect, ... 15

15 (Median lobes of the pygidium with entire inner margins
(parallel, often contiguous, ... Hemichionaspis
(Median lobes of the pygidium with a part of their inner
(margins divergent, ... Chionaspis

16 (A conspicuous club-shaped pair of thickenings projecting in-
(ward from between the median lobes of the pygidium, ... Howardia
(No such thickenings projecting inward from between the
(median lobes, ... 17

17 (Dorsal tubular spinnerets of the pygidium not arranged in
(regular bands, ... Diaspis
(Dorsal tubular spinnerets of the pygidium arranged in
(regular bands, ... 18

18 (Circumgenital glands in six groups, ... Comstockiella
(Circumgenital glands in less than six groups, ... 19

19 (Circumgenital glands in two groups, ... Odonaspis
(Circumgenital glands not in two groups, ... 20

20 (Scale composed almost entirely of second exuvia, ... Aonidia
(Scale composed largely of secretion, ... 21

21 (With less than three pairs of lobes, ... 22
(With at least three pairs of lobes, ... 23

22 (With two pairs of lobes, ... Xerophilaspis
(With one pair of lobes, ... Pseudodiaspis

23 (With more than three pairs of lobes, ... 24
(With three pairs of lobes, ... 25

24 (With five pairs of lobes, ... Epidiaspis
(With four pairs of lobes, ... Pseudaonidia

25 (Abdomen sharply separated from the thorax, ... Selenaspidus
(Abdomen broadly joined to the thorax, ... 26

26 (Median lobes with a pair of divergent spine-like plates be-
(tween them, ... Pseudoparlatoria
(Median lobes without such plates between them, ... 27

27 (First exuvia bearing legs and antennae, ... Aulacaspis
(First exuvia not bearing legs and antennae, ... 28

28 (Scale closed beneath by a secretional layer, ... Targionia
(Scale not so closed, ... 29

29 (Chitinous processes at bases of the lobes elongate, longer
(than incisions between the lobes, ... Chrysomphalus
(Chitinous processes short, not longer than incisions be-
(tween the lobes, ... Aspidiotus

LEPIDOSAPHES

TABLE OF SPECIES.

1 (Circumgenital glands absent, ... 2
(Circumgenital glands present, ... 6

2 (One or two strong, pointed processes on each lateral margin of the last abdominal segment just before the base of the pygidium, ... argentata
(No such processes present, ... 3

3 (Plates of the posterior margin of the pygidium prolonged into long hairs, ... crotonis
(Plates not prolonged into long hairs, ... 4

4 (Lateral margins of the body with a deep indentation at the posterior end of the mesothorax, so that the mesothorax is distinctly separated from the metathorax, ... philococcus
(Lateral indentations absent, ... 5

5 (Dorsal tubular spinnerets arranged in regular bands, .townsendiana
(Dorsal tubular spinnerets scattered irregularly over the pygidium, ... alba

6 (Circumgenital glands scattered, ... 7
(Circumgenital glands in regular groups, ... 8

7 (Scales grayish white, ... concolor
(Scales bright green, ... concolor viridissima

8 (Circumgenital glands in four groups, ... 9
(Circumgenital glands in five groups, ... 11

9 (Scale living beneath the epidermis of the leaf, ... crawii
(Scale not living beneath the epidermis of the leaf, ... 10

10 (Three pairs of small lobes on the posterior margin of the pygidium, ... carinata
(Two pairs of well developed lobes on the posterior margin of the pygidium, ... nigra

11 (Anterior group of circumgenital glands consisting of not more than three glands, ... flava
(Anterior group of more than three glands, ... 12

12 (Three pairs of lobes on the posterior margin of the pygidium, ...mexicana
(Less than three pairs of lobes present, ... 13

13 (One pair of lobes on the posterior margin of the pygidium, ... 14
(Two pairs of lobes present, ... 15

14 (Anterior lateral group of circumgenital glands consisting of not more than ten glands, ... chilopsidis
(Anterior lateral group consisting of more than ten glands, ... mimosarum

15 (Ventral scale complete, ... 16
(Ventral scale divided along the median longitudinal line, ... 17

16 (Second row of dorsal tubular spinnerets in one continuous line, ... beckii
(Second row of dorsal tubular spinnerets divided into two groups distinctly separated from one another, ... pinnaeformis

17 (Median lobes longer than wide, ... gloveri
(Median lobes much wider than long, ... ulmi

DESCRIPTIONS OF GENERA

In the preparation of this paper no endeavor has been made to deal with all of the genera listed under the Diaspinae for the entire world. Only those genera that are represented in the territory of North America down to the Isthmus of Panama with the adjacent islands have been treated, and only those species found in the above named territory are listed under the various genera.

PROTODIASPIS

The female insect is small and secretes no distinct scale but envelopes itself in cottony secretion. Numerous small, round glands scattered in the skin. A group of glands resembling circumgenital glands on each side of the mouth parts. No circumgenital glands. Four very low, broad, rounded lobes on the posterior margin of the pygidium. Very small spines present but no gland spines.

The male scale like that of Diaspis but extremely short.

It was not possible for the author to obtain specimens of the single species of this genus, and it was therefore necessary to compile the above description from Cockerell's original description published in Annals and Magazine of Natural History, Series 7, Vol. I, p. 428, 1898.

Protodiaspis parvula Ckll. Mexico.

XANTHOPHTHALMA

The female scale very small, oval and with the exuviae occupying a very large part of it; the first exuvia is small, oval, bears both legs and antennae, and overlaps the second; the second is somewhat larger, oval, and is more or less covered by a thin film of secretion. The ventral scale is well developed and partly adheres to the dorsal scale. Gland orifices and gland spines absent. A few dorsal tubular spinnerets. No circumgenital

glands. Three pairs of lobes on the posterior edge of the pygidium. Gland spines and spines absent.

So far, there appears to be some question as to whether the male of the single species in this genus has ever been collected. There were no males present in the material examined by the author.

Xanthophthalma concinnum Ckll. & Parr., Mexico.

CHIONASPIS

The female scale varies considerably in shape in different species, and is also modified somewhat by the conformity of the surface on which it rests. It is pointed at the anterior end and widened posteriorly to a varying degree. The exuviae are at the anterior end and oval; the first small, slightly overlapping the second and bearing both legs and antennae; the second much larger, covered by a slight film of secretion. The ventral scale is thin, developed more strongly anteriorly and along the sides where it adheres to the dorsal scale in the form of a narrow band. Gland orifices and gland spines present on the outer edges of the mesothoracic, metathoracic and abdominal segments, more numerous posteriorly. The dorsal tubular spinnerets are arranged in regular rows. The circumgenital glands are in five groups, though species may be found which do not possess these. Two or three pairs of lobes on the posterior edge of the pygidium, the second and third pairs are bilobed with the inner sections the larger. Gland spines and spines present.

The male scale is small, parallel sided and pointed at the anterior end where the exuvia is located. The ventral scale is well developed.

Chionaspis americana Johnson, Mass., Conn., N. Y., Ohio, Ill., Mo., Kan., Tex., Minn., Okla.

assimilis Mask., Cal. (at quarantine from Australia).

caryae Cooley, Washington, D. C.

citri Comst., S. States, W. Indies, Bermuda, Mexico.

corni Cooley, Mass., Ohio.

difficilis Ckll., Cal. (at quarantine from Japan).

euonymi Comst., Mass., N. Y., Va., Ga., Ohio, Conn.

furfura (Fitch), Canada, N. S., P. E.I., U. S.

furfura fulva King, Mass.

furfura ulmi Ckll., Tex.

gleditsiae Sanders, Ohio, Pa., W. Va., Ind., Va., D.C.

howardi Cooley, D. C.

lintneri Comst., Can., Mass., N. Y., P. E. I.

lintneri betulae Cooley, P. E. I.

longiloba Cooley, Texas.

major Ckll., Antigua.

ortholobis Comst., Mass., Ohio, Mo., Kan., Neb., S.Cal., N. Mex.

pinifoliae (Fitch), Canada, U. S.

pinifoliae semiaurea Ckll., U. S.

pinifoliae heterophyllae Cooley, R. I., Fla.

platani Cooley, Kan.

Chionaspis quercus Comst., Cal., N. M.

salicis (Linn.)

salicis nigrae (Walsh), Can., Me., Mass., N. Y., Ohio, Ind., Ill., Minn., Ia., Mo., Neb., Kan., Col., N. Mex., Ariz., Wash., Cal.

sassceri Ckll. & Robbins, Cal.

spartinae Comst., Mass., Cal.

sylvatica Sanders, Chio, Pa., W. Va., Ind., Va., D. C.

wistariae Cooley, Cal.

HOWARDIA

The female scale is irregularly circular, covered with a layer of dead plant tissue and is moderately convex. The exuviae are at the margin; the first is small, oval, projects almost entirely beyond the margin, slightly overlaps the second and bears both legs and antennae; the second is much larger, irregularly circular, placed just inside the margin and is nearly concealed by a layer of secretion and dead plant tissue. The ventral scale is well developed and a narrow band of it adheres to the dorsal scale. The gland orifices and gland spines are present on the outer edges of the mesothoracic, metathoracic and abdominal segments and increase in size and number posteriorly, the gland spines on the last three abdominal segments being quite long. The dorsal tubular spinnerets

are numerous and are arranged in irregular lines extending inward from the posterior edge of the pygidium. Circumgenital glands absent. There are three pairs of lobes on the posterior edge of the pygidium; first pair are prominent and have two large club-shaped organs extending inward from between them, the last two pairs of lobes are scarcely developed. Gland spines and spines present.

The male of the single species in this genus has not as yet been collected.

Howardia biclavis (Comst.), Washington,D. C., Ohio, Cal., Mex., W. Ind.

DIASPIS

The female scale is irregularly circular and usually both exuviae are situated entirely inside of the margin where their position varies from central to marginal, though occasionally the first projects slightly beyond the margin; the first is minute, oval, overlaps the second to a varying degree and bears both legs and antennae; the second is large and subcircular. Both exuviae are covered to a varying degree with secretion which is thicker over the second. The ventral scale is very thin except around the edge where it is somewhat thicker and where it adheres to the dorsal scale in the form of a narrow band. The gland orifices and gland spines are present on all segments and increase in size and number

posteriorly. The dorsal tubular spinnerets are arranged irregularly over the pygidium. The circumgenital glands are in five groups, though possibly species may be found which lack these. There are three pairs of lobes on the posterior edge of the pygidium, the second and third pairs being bilobed. Gland spines and spines present.

The male scale is small, parallel sided and pointed at the anterior end where the exuvia is located. The ventral scale is well developed.

Diaspis arizonica Ckll., Ariz.

baccharidis Towns. & Ckll., Mex.

boisduvalii Sign., W. Ind., Mex. (In greenhouses,) Can., N. Y., Washington, D.C., Ohio, Mass.

boisduvalii coccois Licht., Jam.

boisduvalii maculata (Ckll.), Antigua.

bromeliae (Kern.), Mass., Washington,D.C., Chio, Cal. (in quarantine) Mex.

carueli Targ., Mass., N. Y., Washington,D. C.

cattleyae (Ckll.), Mex., Cal.

celtidis Ckll., Texas.

echinocacti (Bouché), Porto Rico, Mex., N. Mex., N. Y.

echinocacti cacti Comst., Mass. and N. Y.(in quarantine), Ia., Ariz., N. Mex.

echinocacti opuntiae Ckll., Texas, Mex., Jam.

minima Targ., Mass. (Harvard Botanical Garden).

miranda (Ckll.) Mexico.

montana (Ckll.), N. Mex.

Diaspis phoradendri Ckll., Mex.

texensis (Ckll.), Tex.

toumeyi Ckll., Ariz.

townsendi Ckll., Mex.

zamiae Morg., Bermuda ? N. Y., Mass. (in ~~quarantine~~ greenhouses.)

AULACASPIS

The female scale is irregularly circular with the exuviae situated near the margin; the first is small, oval, overlaps the second to a varying degree and bears both legs and antennae; the second is much larger, oval and slightly covered by secretion. The ventral scale is thin and practically none of it adheres to the dorsal scale. The gland spines are small and few in number on the head and thoracic segments, and are longer and more numerous on the two abdominal segments. The gland orifices are present on the two abdominal segments. The dorsal tubular spinnerets are arranged in regular rows. Circumgenital glands in five groups. There are three pairs of lobes on the posterior edge of the pygidium, those of the second and third pairs are bilobed with the inner lobule the larger. Gland spines and spines present.

The male is small, parallel sided and pointed at the anterior end where the exuvia is located. The ventral scale is well developed.

Aulacaspis crawii (Ckll.), Cal. from China.

pentagona (Targ.), W. I., Mass., Washington,D.C., Ohio, Ga., Fla., Cal., Pan.

pentagona auranticolor (Ckll.), Cal.

persimilis (Ckll.), Mex.

rosae (Bouché), W. I., Can., Mex., N. Y., Fla., Ohio, Cal.

PHENACASPIS.

The female scale is pointed at the anterior end where the exuviae are located and broadly rounded posteriorly, so that it is pyriform in outline. The first exuvia is small, oval, overlaps the second, bears both legs and antennae, and sometimes has a slight amount of secretion on it; the second is much larger, oval, and is slightly covered by a film of secretion. The ventral scale is thinly developed and practically none of it adheres to the dorsal scale. The gland orifices and gland spines are small and few on the head and thoracic segments, becoming larger and more numerous on the two abdominal segments. The dorsal tubular spinnerets are present in regular bands. Circumgenital glands in five groups. There are two or three pairs of lobes on the posterior edge of the pygidium; the first pair is set into the margin so that their inner margins only are free, the lobes of the remaining pairs are short and bilobed with the inner lobule the larger. Gland spines and spines present.

The male scale is small, parallel sided and pointed at the anterior end where the exuvia is located. The ventral scale is well developed.

Phenacaspis aucubae (Cooley), Cal., (at quarantine from Japan).
chinensis (Ckll.) Cal., (at quarantine from China).
cockerelli (Cooley), Cal. (at quarantine from China).
latissima (Ckll.), Cal.
nyssae (Comst.), N. C., Ga.

HEMICHIONASPIS

The female scale is pointed at the anterior end where the exuviae are located, and pyriform; the first exuvia is small, oval, overlaps the second and bears both legs and antennae; the second is much larger, oval, and slightly covered by a film of secretion. The ventral scale is thinly developed as a whole, but around the margin it is slightly thicker and adheres to the dorsal scale in the form of a narrow band. The gland orifices and gland spines are few and small on the anterior part of the body, and they increase in number and size posteriorly. The dorsal tubular spinnerets are arranged in regular rows. Circumgenital glands in five groups. There are from one to three pairs of lobes on the posterior edge of the pygidium, those of the median pair are large and have their inner margins straight and approximate; the

second and third pairs when present are bilobed with the inner lobule the larger. Gland spines and spines present.

The male scale is elongate, small, parallel sided and pointed at the anterior end where the exuvia is located. The ventral scale is well developed.

Hemichionaspis aspidistrae (Sign.), Trinidad, Can. in quarantine, Mass. (Harvard Botanical Garden), Washington,D.C., Cal.

minor (Mask.), Antigua, Jamaica, Panama, Fla.

PINNASPIS

The female scale is flat, pointed at the anterior end, and pyriform. The exuviae are oval and situated at the anterior end; the first is small, overlaps the second and bears both legs and antennae; the second is very much larger, extending over one-third the length of the scale, is oval, and covered by a thin film of secretion. The ventral scale is scarcely developed except anteriorly and laterally where a narrow band of it adheres to the dorsal scale. The gland orifices and gland spines are few and small anteriorly, they increase in number and size posteriorly but are not very numerous, the spines are especially well developed on the last abdominal segments. The dorsal tubular spinnerets are not present on the main portion of the pygidium, the only ones found on this portion of the body being several placed along the posterior

margin. Circumgenital glands in five groups. Gland spines and spines present.

So far as can be determined the male scales of the species in this genus have not been collected. Newstead in his "Monograph of the British Coccidae," describes and figures a form which he thinks may be the male of P. buxi, but he expresses some doubt as to the specimen he found really being the male.

Pinnaspis bambusae Ckll., Jamiaca.

buxi (Bouché), Mass., N. Y., Jamiaca, Trinidad, Panama.

buxi alba Ckll., Trinidad.

POLIASPIS

The female scale is pointed at the anterior end and somewhat pyriform. The exuviae are oval and situated at the anterior end; the first exuvia is small, overlaps the second and bears both legs and antennae; the second is much larger and more or less covered by a film of secretion. The ventral scale is well developed and adheres to the dorsal scale on the sides in the form of a narrow band. The gland orifices and gland spines are numerous, especially on the abdominal segments. The dorsal tubular spinnerets arranged in regular bands extending inward from the rear margin of the pygidium. Circumgenital glands in eight groups. There are two or three pairs of lobes on the rear margin of the pygidium. Circum-genital glands in eight groups. There are two or three pairs of

lobes on the rear margin of the pygidium, the median lobes are large, the second pair is much smaller and bilobed, and the third pair when present are very small. The gland spines and spines are present.

The male scale is small, pointed at the anterior end, and nearly parallel sided with the exuvia at the anterior end. The ventral scale is well developed.

Poliaspis cycadis Comst., Washington, D.C.

LEUCASPIS

The puparium of the species making part of this genus much resembles that of Mytilaspis; it is long, a little enlarged at the extremity and sharpened toward the cephalic portion. It is in the form and characters of the females that one finds especially the differences; the border of the anal segment is ciliated its entire extent with thorn-like hairs, blunt at the extremity.

As for the disposition of the "filieres," that I have at first indicated as characters of the genus, it is too variable in the two species that we know, to serve as a character for a genus and will only serve specifically. The female presents rudiments of aborted antennae that we have seen equally in some Mytilaspis.

The male is very long; the thorax very large, occupying alone more than half of the length of the insect. The antennae are long

and very pubescent, except the three first segments; the last has four very large button-tipped hairs; the tarsi are pubescent and have four hairs, thickened at the extremity, at the articulation of the claw.

The rest as for Mytilaspis.

This description is translated direct from Signoret's description in Annales de la Société Entomologique de France, 4th series, Vol. X, page 100, 1870, as it was not possible for the author to obtain specimens of the type species. There appears to be considerable confusion in regard to this genus, some of the species now listed under it can hardly belong there if we take Signoret's description as correct, unless as is the case with at least one description I have encountered, the second exuvia has been described as the insect itself. I have had the opportunity of examining only one species of this genus-- the Leucaspis pini of Berlese and Leonardi in Chermotheca Italica, listed by Cockerell as L. lecnardi. It agrees well with Signoret's description of the genus, but unless one were acquainted with this genus, he would be almost certain to mistake the second exuvia for the scale, as they are very hard to separate, and the exuvia is under the shield in the exact position of the insect itself.

Leucaspis japonica Ckll., Cal.

cupressi Coleman, Cal.

kelloggi Coleman, Cal.

indica Marlatt, Miami, Fla.; Mayaguez, P.R.; (imported from India).

FIORINIA

The female scale is generally elongate oval, but often the sides are nearly parallel; it is pointed at the anterior end where the first exuvia is located, and consists mainly of the second exuvia which is very large and is covered by a thin film of secretion which extends beyond the exuvia as a narrow almost transparent border. The first exuvia is small, oval, slightly overlaps the second and bears both legs and antennae. The ventral scale is formed from the ventral portion of the second exuvia, so that the insect is enclosed in a kind of envelope. The gland orifices and gland spines are present, few anteriorly, increasing in number posteriorly, but not very numerous. The circumgenital glands are usually in five groups though some species do not possess these. Gland spines and spines present. On the posterior margin of the pygidium there is a median pair of well developed lobes with sometimes two small lobes on each side of these.

The male scale is small, parallel sided and pointed at the anterior extremity where the exuvia is located. Ventral scale well developed.

Fiorinia fioriniae (Targ.), Jamaica, Barbados, Mex., Mass., Ind., Washington,D.C.(in ~~quarantine~~ greenhouses), La., Col., Cal.

EPIDIASPIS.

The female scale is irregularly circular with the exuviae central or subcentral and covered by a thin film of secretion; the first exuvia is small, subcircular, superimposed on the second and lacking legs and antennae. The second is the same form as the first and somewhat larger. The ventral scale is thinly developed, composed partially of the ventral portion of the first exuvia, and sometimes a narrow band of it adheres to the edge of the dorsal scale. The position of the ventral portion of the first exuvia is readily determined by the ventral scale being thicker at the point where it lies. The gland orifices and gland spines are few and minute on the head and thorax, while they are more numerous and slightly larger on the three abdominal segments. Five groups of circumgenital glands. The dorsal tubular spinnerets present and not arranged in regular rows, those just inside the margin being large while those on the body of the pygidium are much smaller. There are five pairs of lobes, the middle pair are large, the others small, decreasing in size, with the fifth pair hardly visible; the second and third pairs are bilobed. The positions of the lobes beyond the first pair are best indicated by the chitinous processes each side of the incisions between the lobes, for many times the lobes themselves are not well chitinized. Gland spines and spines present.

I was not able to obtain specimens of the male of the single species under this genus, but from descriptions hitherto published, it appears that the male scale is small, parallel sided and pointed at the anterior end where the exuvia is located.

Epidiaspis piricola (Del Guer.), N. Y., Cal.

ASPIDIOTUS

The female scale is irregularly circular, the exuviae are central or subcentral and both are more or less covered by secretion, the second is always covered and the first may be, though in its exposed position the secretion is very apt to be rubbed off; the first exuvia is small, subcircular, superimposed on the second, and is minus legs and antennae; the second is subcircular and much larger. The ventral scale is composed partly of the ventral portion of the first exuvia. It varies much in thickness, and in the amount that adheres to the dorsal scale, in different species. The gland orifices and gland spines present and increasing in number and size posteriorly. The dorsal tubular spinnerets vary considerably in form, size and position, so that it is not possible to assign any generic value to them, outside of the fact that they are present. The circumgenital glands may be lacking or present in four or five groups. Gland spines and spines present.

The male scale is of somewhat the same shape as the female, though it is on the whole more or less oval and has the exuvia in

a central or subcentral position. The ventral scale of the male varies about as it does in the female.

Aspidiotus abietis (Schr.), Me., Mass., N. Y., N. J., Ga.

aesculi Johnson, Cal.

aesculi solus Hunter, Kan.

ancylus (Putn.), Can., Mass., N. Y., N. J., Del., Md., D. C., Va., Ga., Ohio, Ill., Ia., Minn., Kan., Col., N. Mex., Wash.

ancylus serratus Newell & Ckll., Iowa.

ancylus latilobis Newell, Iowa.

arctostaphyli Ckll. & Robbins, Cal.

britannicus Newst., Mass., Ore.

candidulus Ckll., Ariz.

coloratus Ckll., N. Mex.

comstocki Johnson, N. Y., Ohio, Ill., Ia.

coniferarum Ckll., N. Mex.

cupressi Ckll., Mex.

cyanophylli Sign., Mex. (in greenhouses), Mass); Washington, D. C.; Ohio.

cydoniae Comst., Ga., Fla., Tex., Kan., N. Mex., Mex., W. Ind.

cydoniae crawii Ckll., Mex., Mass. (in greenhouse)

cydoniae punicae Ckll., Jamaica, Dominica, N. Y., Ia.

destructor Sign., W. Ind., Mex.

diffinis Newst., Mex., Washington,D.C.; Can.

diffinis parrotti Newell, Mex.

fernaldi Ckll., Mass., Kan.

Aspidiotus fernaldi abliventer Hunter, Kan.

fernaldi hesperius Ckll., Ariz.

forbesi Johnson, Can., N. S., Mass., N. Y., N. J., Md., W. Va., Ga., Fla., Ala., Ohio, Ill., Kan., N. Mex., Porto Rico, Mex.

glanduliferus Ckll., Ohio.

hartii Ckll., W. Indies.

hartii luntii Ckll., Trinidad.

hederae (Vall.), Bermuda, W. Ind., Mex., Ga., Fla., Cal., Ohio, Can.

howardi Ckll., Col., N. Mex.

hunteri Newell, Ia., Tex.

juglans-regiae Comst., Can., Mass., N. Y., D. C., Miss., La., Tex., N. Mex., Cal., Ohio.

juglans-regiae pruni Ckll., N. Mex.

juglans-regiae albus Ckll., N. Mex.

lucumae Ckll., Mex.

mori Herrick, Tex.

nigropunctatus Ckll., Mex.

osborni Newell & Ckll., Kan., Ia., Ga.

ostreaeformis Curt., P.E.I., Ontario, N. Y., N. J., Mich., Ohio, Iowa, Idaho, Cal., Mass.

palmae Morg. & Ckll., W. Indies.

perniciosus Comst., Can., U. S.

perniciosus albopunctatus Ckll., Cal.

rapax Comst., U.S. (in greenhouses in the north), W. Ind., Mex. ?

Aspidiotus sacchari Ckll., Jamaica, Barbados, Antigua.

spinosus Comst., Washington D.C. (in greenhouses).

subsimilis Ckll., Mex.

townsendi Ckll., Mex., Ariz.

tricolor Ckll., Mex.

ulmi Johnson, Ill., Kan., N. Y.

uvae Comst., Ohio, Ill., Ind., Tenn., Kan., Fla. Jamaica.

vagabundus Ckll., Mex.

californicus Coleman, Cal.

coniferarum shastae Coleman, Cal.

ebrhorni Coleman, Cal.

florenciae Coleman, Cal.

ohioensis York, Ohio.

oxycoccus Woglum, N. J.

piceus Sanders, Chio.

pseudospinosus Woglum, Fla.

cocotiphagus Marlatt, Cuba.

coursetiae Marlatt, Mex.

densiflora Bremner,Cal.

eglandulosus Lindinger, Guatemela, Panama.

epigaeae Marlatt, Va., Ohio.

popularum Marlatt, Ariz., N. Mex.,

yulupae Bremner, Cal.

CRYPTOPHYLLASPIS

The insects form galls on the upper surface of the leaves, those formed by the female are true galls but those formed by the males are only shallow depressions; the insects settle down on the under surface of the leaves and the gall is formed gradually. The aperture of the gall is on the ventral surface and is closed by a thin film of secretion which may be considered as similar to the ventral scale of other forms. Both the insect and the exuviae lie inside of the gall; the first exuvia is small, nearly circular and bears both legs and antennae; the second is large, sometimes even larger than the insect itself, and is nearly circular. Gland orifices and gland spines present. No circumgenital glands. A few filiform tubular spinnerets. Three pairs of lobes. Gland spines and spines present.

The male scale is oval and flat, with the circular exuvia toward one end.

Cryptophyllaspis liquidambaris Kotinsky, Washington, D.C.; Atlanta, Ga.

COMSTOCKIELLA

The female scale is subcircular, with the exuviae varying in position from central to marginal, their position indicated by a slight prominence, as both are usually covered by secretion. The

The first exuvia is very small, subcircular, superimposed on the second and lacks both legs and antennae; the second is larger and subcircular in outline. The ventral scale is very thin but it is slightly thicker where the ventral portion of the first exuvia is placed, and a very narrow band of it adheres to the dorsal scale. The gland orifices and gland spines are present. They are small and increase in number posteriorly. The dorsal tubular spinnerets are arranged in regular bands. The circum-genital glands are in six groups. There are no lobes present on the posterior margin of the pygidium, but there is a notch in the middle of this margin which gives the appearance of a couple of lobes. The gland spines and spines are present.

The scale of the male is much like that of the female in shape, but it is usually somewhat oval; the exuvia is variable in its position from central to marginal and the ventral scale is well developed.

Comstockiella sabalis (Comst.), Fla.

sabalis mexicana Ckll., Mexico.

PSEUDACONIDIA

The scale of the female is subcircular and is more or less covered by a layer of dead plant tissue; the exuviae are central or subcentral, sometimes both are covered by a layer composed of

secretion and dead plant tissue, but usually the first one is naked; the first exuvia is oval, small, placed on the second and lacks both legs and antennae; the second is oval and is much larger than the first. The ventral scale is strongly developed, is more conspicuous where the ventral portion of the first exuvia is placed, and it adheres to the dorsal scale in the form of a narrow band. The gland orifices and gland spines are small, few and scattered on the head and thoracic segments, and they are somewhat larger and very numerous on the abdominal segments. The dorsal tubular spinnerets are arranged in regular rows. The circumgenital glands vary in number of groups, or may even be absent. There are four pairs of lobes on the posterior margin of the pygidium. The space on the pygidium enclosed by the circumgenital glands is covered by a peculiar lattice work formation.

So far as can be determined, the male of this genus has not been discovered.

Pseudaonidia duplex (Ckll.), Washington, D. C.: Cal. (in Japanese nursery).

paeoniae (Ckll.), Cal.

tesserata (de Charm.), Mex., Antigua.

SELENASPIDUS

The scale of the female is subcircular, it is very thin and semi-transparent, so that one may see the insect concealed beneath it; the exuviae are central or subcentral and are more or less covered by a film of secretion; the first is small, round, superposed on the second to a varying degree and lacks both legs and antennae; the second is much larger and round. The ventral scale is thinly developed, slightly more prominent where the ventral portion of the first exuvia is, and a broad band of it adheres to the dorsal scale. The gland orifices and gland spines are absent. The abdomen is divided to a marked degree from the thorax. The dorsal tubular spinnerets placed in two groups of large number along the hind margin of the pygidium, principally toward the mid line. The circumgenital glands are in two groups. There are two pairs of lobes on the posterior margin of the pygidium. The gland spines and spines are present.

The male scale is very small, parallel sided and pointed at the anterior end where the exuvia is situated. The ventral scale is well developed.

Selenaspidus articulatus (Morg.), W. Ind., Panama, Mexico.

CHRYSOMPHALUS

The female scale is circular or subcircular with the exuviae central or subcentral and with both usually slightly covered by a film of secretion; the first exuvia is small, circular, superposed on the second and lacks both legs and antennae, the second much larger and circular. The ventral scale is thinly developed but is more prominent where the ventral portion of the first exuvia is and a broad band of it adheres to the dorsal scale. The gland orifices and gland spines are small and few in number. The dorsal tubular spinnerets are arranged in regular rows. The circumgenital glands are in four groups and there are three pairs of lobes on the posterior edge of the pygidium. Between the bases of the lobes are pairs of elongate chitinous thickenings which extend inward. The gland spines and spines present.

The male scale is practically the same shape as that of the female, but is usually somewhat oval, with its exuvia in a central position. The ventral scale is well developed.

Chrysomphalus agavis (Towns. & Ckll.), Mex.

albopictus (Ckll.), Mex.

albopictus leonis (Towns. & Ckll.), Mex.

aonidum (Linn.), Jamaica, Barbados, N. Y., Washington,D.C.; Ga., Fla., La., Tex., Ohio, Cal., Col., N. Mex., Mex.

aurantii (Mask.), W. Ind., N. Y., Fla., Chio, Cal.

aurantii citrinus (Coq.), Cal.

Chrysomphalus biformis (Ckll.), Jamaica, Trinidad, Grenada, Antigua.

biformis cattleyae (Ckll.), Jamaica.

calcurus (Ckll.), Mex.

dictyospermi (Morg.), W. Ind., Mex., U. S. (in greenhouses).

dictyospermi pinnulifera (Mask.), Jamaica.

dictyospermi mangiferae (Ckll.), Jamaica.

dictyospermi arecae (Newst.), W. Ind.

koebelei (Towns. & Ckll.), Mex.

lilacinus (Ckll.), Mex.

mimosae (Comst.), Mex.

obscurus (Comst.), Washington, D.C.; Fla., Ohio, Ill., Kan.

odontoglossi (Ckll.), Jamaica.

perseae (Comst.), Fla., Mex.

personatus (Comst.), W. Ind., Mex.

reniformis (Ckll.), Mex.

rhizophorae Ckll., Mex.

scutiformis (Ckll.), Mex., Cent. Am.

smilacis (Comst.), Mass.

sphaerioides (Ckll.), La.

tenebricosus (Comst.), Washington, D.C.; Ga., Cal.

tonilensis Ckll., Mex.

PSEUDISCHNASPIS

The scale of the female is elongate and is of nearly the same width throughout its length. The exuviae are placed at the anterior end, both somewhat covered by a film of secretion, the second more so than the first and neither one concealed by it; the first is small, oval, superposed on the second and bearing legs and antennae; the second is much larger and nearly circular. The ventral scale is well developed and adheres completely to the dorsal scale. The gland orifices and gland spines are few and small; the dorsal tubular spinnerets are few in number, they are long and placed in regular rows. There are four groups of circumgenital glands, three pairs of lobes on the posterior edge of the pygidium. The gland spines and spines are present.

The male scale is similar in form to the female but it is much smaller, the exuvia is at the anterior end and the ventral scale is well developed.

Pseudischnaspis bowreyi (Ckll.), Jamaica, Mex.

longissima (Ckll.), Mex.

PSEUDODIASPIS

The scale of the female varies from circular to subcircular and the exuviae are placed nearly centrally, both are usually covered by secretion; the first exuvia is small, subcircular,

superposed on the second and lacks both legs and antennae; the second is somewhat larger and is circular.

The ventral scale is fairly well developed and is somewhat more prominent where the ventral portion of the first exuvia is, practically none of the ventral scale adheres to the dorsal. The gland orifices and gland spines are few and small; the dorsal tubular spinnerets are in regular rows; no circumgenital glands present. On the posterior edge of the pygidium there is one pair of lobes; the gland spines and spines are present.

The male scale is elongate and parallel sided with the exuvia at the anterior end. The ventral scale is well developed.

Pseudodiaspis dentilobis (Ckll.), Mex.

larreae (Ckll.), Ariz.

TARGIONIA

The scale of the female is subcircular with the exuviae varying from central to subcentral, both are usually covered by secretion, though often the secretion is removed from the first; the first is small, circular, superposed on the second and lacks legs and antennae; the second is circular and somewhat larger than the first. The ventral scale is complete and remains attached to the dorsal scale, forming a complete sack in which the insect is enclosed. Gland orifices and gland spines present. The dorsal tubular spinnerets are arranged in regular bands, the

circumgenital glands when present are somewhat scattered and not arranged in regular groups. On the posterior margin of the pygidium there are several lobes, the number varying according to the species. Gland spines and spines present.

The male scale varies somewhat in shape, usually it is oval with the exuvia toward one end, the ventral scale is complete.

Targionia bigeloviae (Ckll.), Cal.

cueroensis (Ckll.), Tex.

dearnessi (Ckll.), Bruce Peninsula, shores of Lake Huron; Can.

celtis Herrick, Tex.

graminella (Ckll.), N. Mex., Col.

gutierreziae (Ckll. & Parr.), N. Mex.

helianthi (Parr.), Kan.

marlatti (Parr.), Kan.

parkinsoniae (Ckll.), Ariz.

yuccae (Ckll.), Ariz.

yuccae neomexicana (Ckll.), N. Mex.

yuccarum Ckll., N. Mex.

XEROPHILASPIS

The scale of the female varies somewhat in shape but is usually nearly circular with one side somewhat prolonged into a broad point, so in extreme cases the whole is rather mytiliform than circular; the exuviæ occupy the major portion of the scale and the secretion only extends beyond the second exuvia in a narrow band; the first exuvia is small, circular, superposed on the second and lacks both legs and antennae; the second is much larger, is pointed at one side and is somewhat covered by a film of secretion. The ventral scale is quite well developed and is somewhat more prominent where the ventral portion of the first exuvia is situated, and a narrow band of it adheres to the dorsal scale. Gland orifices and gland spines few and small. The dorsal tubular spinnerets are arranged in regular rows; no groups of circumgenital glands. There are two pairs of small lobes on the posterior edge of the pygidium. Gland spines and spines present.

The male scale somewhat larger than the female, oval, exuvia toward one end, and the ventral scale is complete.

Xerophilaspis prosopidis (Ckll.), Ariz., Mex.

ODONASPIS

The scale of the female varies considerably in shape, some are circular and still others are broadly oval, while the exuviae vary from central to marginal in position; in some species the insect

after the second molt, tunnels beneath a dry petiole sheath of the plant, leaving the exuviae on the outside and many times these cannot be found, as they are easily brushed off. The exuviae may or may not be covered by a film of secretion; the first is small, nearly oval, slightly pointed at one end, overlaps the second to a varying degree and lacks both legs and antennae; the second is much larger and is of the same shape as the first.

The ventral scale is almost as well developed as the dorsal scale, the secretion combined with the ventral portion of the first exuvia gives to the ventral scale the same appearance as the dorsal, so that in many cases it is hard to tell which is the dorsal and which the ventral, after the scale is removed from the bark, as the ventral scale adheres completely to the dorsal scale.

The gland orifices and gland spines are few in number and small. The dorsal tubular spinnerets are arranged in regular rows. The circumgenital glands, when present, in two groups. There are four pairs of lobes on the posterior edge of the pygidium, the median pair prominent, but the three other pairs are very broad and project but slightly from the margin. Gland spines and spines present.

The male scale is modified oval in form, somewhat narrow at one end and broader at the other where the exuvia is located; the ventral scale is complete.

Odonaspis bambusarum (Ckll.), Cal. from Japan.

graminis Bremner, Cal.

graminis ruthae Ehrhorn, Cal.(at quarantine).

PSEUDOPARLATORIA

The scale of the female is subcircular, though often irregular, with the exuviae varying in position from central to nearly marginal; the first exuvia is small, oval, superposed on the second and lacks both legs and antennae; the second is much larger, circular and covered by a film of secretion. The ventral scale is moderately well developed, strongest where the ventral portion of the first exuvia is, and practically none of it adheres to the dorsal scale. The gland orifices and gland spines are few in number and small in size. The dorsal tubular spinnerets are arranged in regular rows. The circumgenital glands are in four groups. There are three pairs of lobes on the posterior edge of the pygidium. Gland spines and spines present.

The male scale is long with nearly parallel sides and the exuvia at the anterior end. The ventral scale is well developed.

Pseudoparlatoria ostreata Ckll. Jamaica.

parlatorioides (Comst.), Fla., Mex.

serrulata Towns. & Ckll., Mex.

AONIDIA

The female scale is irregular in outline with a tendency to circular; it consists principally of the second exuvia with a narrow border of secretion; the first exuvia is small, oval, is superposed on the second, in position varying from central to marginal and bears both legs and antennae; the second is very large, of various forms according to the species and is covered by a film of secretion. When the insect molts the second time, in place of shedding the skin it shrinks away from it inside becoming smaller in place of larger, so that the second exuvia forms a complete sack in which the insect is enclosed, the ventral scale being formed by the ventral portion of the second exuvia. Gland orifices and gland spines present. The dorsal tubular spinnerets vary much in size and position and often are absent; the circumgenital glands are absent. The posterior edge of the pygidium varies considerably, in some species there are no true lobes, while in others there may be as many as four pairs. Gland spines and spines present.

The male scale somewhat oval with the exuvia toward one end and with the ventral scale well developed.

Aonidia juniperi Marlatt, Utah.

GYMNASPIS

The female scale is composed entirely of the second exuvia and neither the first exuvia nor any secretion is present; it is circular in outline, convex, hard and polished. The history of these insects is similar to that of any of the Diaspinae until

the second molt, at the time of the second molt the insect is concealed by a scale formed partly of secretion and partly of the first exuvia; the scale is then shed and the female shrinks away from the skin and remains entirely enclosed in the second exuvia which becomes hard. The ventral scale is thin; composed partly of the ventral portion of the first exuvia and it adheres entirely to the second exuvia. Gland orifices and gland spines present. A few long dorsal tubular spinnerets present near the posterior margin of the pygidium. There are no circumgenital glands on the pygidium. On the posterior edge of the pygidium is a fringe of blunt tubercles. Gland spines and spines present.

The male scale broadly oval with the large exuvia at one end and the ventral scale complete.

Gymnaspis aechmeae Newst., N. Y.

clusiae Lindinger, Jamaica.

ISCHNASPIS

The scale of the female is very long and narrow with the exuviae at the anterior end; the first is oval, small, overlaps the second and bears both legs and antennae; the second is much larger, oval and covered by a film of secretion. The ventral scale is well developed and adheres to the dorsal scale throughout its entire length, with the exception of a small portion at the

extreme tip. Gland orifices and gland spines present. There are a very few small dorsal tubular spinnerets; three groups of circumgenital glands; three pairs of lobes on the posterior edge of the pygidium. Gland spines and spines present. The mid-dorsal surface of the pygidium with a peculiar lattice-like formation.

The male scale very much smaller than the female, oblong, with the exuvia at the anterior end and with the ventral scale well developed.

Ischnaspis longirostris (Sign.), W. Ind., Pan., Washington, D. C. (in greenhouses).

PARLATORIA

The female scale varies in shape from nearly oblong to nearly circular, with the exuviae at one end; the first exuvia is small, oval, overlaps the second and bears both legs and antennae; the second is much larger and varies considerably in the form and the percentage of the scale that it occupies, and it may be naked or covered by a thin film of secretion. The ventral scale is thin and adheres to the dorsal scale to a varying degree.

Gland orifices and gland spines present. The dorsal tubular spinnerets are just inside the posterior margin; there are four or five groups of circumgenital glands and three pairs of lobes on the posterior edge of the pygidium. The entire posterior edge of the pygidium with a row of fimbriated processes; gland spines

and spines present.

The male scale is elongate oval with the exuvia at the anterior end and the ventral scale is complete.

Parlatoria blanchardii (Targ.), Ariz. from Egypt.

crotonis Dougl., Antigua, Jamaica, Mass. (Harvard Botanical Garden.), Panama.

pergandii Comst., D. C., Fla., La., Ohio, Kan., Cal., Mex.

pergandii camelliae Comst., Washington, D. C.(in conservatory).

proteus (Curt.), N. Y., D. C., Kan.

theae Ckll., N. Y. imported on Japanese maple.

ziziphus (Lucas), N. S. on imported fruit.

LEPIDOSAPHES

The typical female scale is pointed at the anterior end and gradually widens to about one-third from the end, from that point it is narrowed slightly and is broadly rounded at the posterior end. While the above is the typical form we find specimens whose form is much different, owing to the conformation of the surface on which they rested or the crowding of individuals on the plant. The dorsal surface of the scale has numerous parallel,curved ridges which are caused by the successive enlargements of the scale to accomodate the increase in size of the insect.

The two exuviae are situated at the anterior end of the scale;

the first is naked, small, oval, it overlaps the second and bears on its anterior edge the antennae and on its posterior ventral surface the rostral apparatus and the legs; the second is covered by a film of secretion, is much larger than the first and is oval.

The ventral scale is strongly developed; the manner of its adhering to the dorsal scale has been considered by many to be of specific value; in some species it remains completely attached when the scale is removed from the plant; in others it ruptures along the median line leaving a narrow section without scale, and in still others only about half of it remains attached anteriorly.

The adult female is broadest one-third from the posterior end, from there it tapers gradually to the anterior end which is truncate and about half as wide as the widest portion; posteriorly the body is rounded suddenly to a rather broad point. The head and three thoracic segments are immovably united; the suture between the head and prothorax is entirely absent but the division is indicated by a small indentation on each lateral margin; the division between the prothoracic and mesothoracic segments at most indicated by a faint suture, while the dividing line between the mesothorax and metathorax is well marked. There are four free abdominal segments with the dividing lines well marked and usually with their outer ends projecting considerably beyond those of the other segments. To the rear of the free segments is a large shield-shaped piece, the pygidium, composed of a number of abdominal segments fused into one piece; if we take eleven as the typical number of abdominal

segments there would be seven in this pygidium, but even the most careful examination fails to show traces of these segments.

The head bears, some distance in from the anterior margin, a pair of rudimentary antennae consisting simply of small knobs bearing two or three rather long, curved spines; behind the antennae is the rostral apparatus consisting mainly of four long setae which go to form the sucking tube.

There are numerous small, nearly circular gland orifices and small gland spines on all of the segments except the pygidium and both are more numerous on the free abdominal segments.

The characters of the pygidium are mainly relied upon for classification and are as follows; the anal orifice which is rather large and circular varies in position from the base of the pygidium to its center, in which case it lies near the genital orifice which is located at that point and which shows as a short doubly curved line. The circumgenital glands when present are placed, as their name signifies, around the genital orifice. In some species the glands are absent, in two although present, they are not arranged in groups but are scattered, in some there are four groups, but most of the species having the glands possess them in five groups. The dorsal tubular spinnerets consisting of short, cylindrical tubes opening onto the dorsal surface through oval pores are in three regular rows each side of the median line; the row is a double one lying directly over the lateral groups of circumgenital

glands, the second is divided into two sections and lies some little distance from the first, and the third, likewise divided, lies near the base of the pygidium. Along the posterior margin there are a number of large marginal tubular spinnerets which open at the margin by large oval pores.

The posterior margin with one, two or three pairs of lobes, the median lobes are short and broad but the others when present are small and sometimes are rather difficult to make out. Besides the lobes there are a number of large gland spines on the margin and a few small spines on the dorsal surface just inside of the margin.

The scale of the male, while it is much smaller, has very much the same shape as that of the female. About one-fourth from the posterior end there is a narrow, thin section which serves as a hinge to enable the rear portion to be elevated and allow the adult male to escape. Only one exuvia is present, located at the anterior end.

ent disc of ♂ from Riley Ins.

The ventral scale is well developed and adheres entirely to the dorsal scale, thus forming a case in which the insect is entirely enclosed until it emerges as the adult.

Lepidosaphes alba (Ckll.), Jamaica, Mex., Fla. from Bahamas, N. Mex.

argentata (Ckll.), Mex.

beckii (Newmn.), Bermuda, W. Ind., Fla., La., Col. Cal.

Lepidosaphes carinata (Ckll.), Mex.

chilopsidis (Marlatt), Mex.

concolor (Ckll.), N. Mex., Col.

concolor viridissima (Ckll. & Parr.), N. Mex.

crawii (Ckll.), Cal.

crotonis (Ckll.), Jamaica.

flava (Targ.), N. Am.

gloverii (Pack.), Middle and Southern U. S., Cal., Mex.

mexicana (Ckll.), Mex.

mimosarum (Ckll.), Mex.

nigra (Ckll.), Mex.

philococcus (Ckll.), Mex.

pinnaeformis (Bouché), N. Am.

townsendiana (Ckll.), Mex.

ulmi (Linn.), Can., U. S.

BIBLIOGRAPHY

The bibliography of the genus Lepidosaphes is that given in Mrs. Fernald's Catalogue of the Coccidae.

In all cases, only additions to Mrs. Fernald's Catalogue are given here, as that work is accurate and complete up to the time it was published.

The genus Lepidosaphes is world wide in its distribution, specimens have been collected in nearly every country of the world, and some of the species have a very wide range.

There is very little that can be written in regard to effects of climatic variation on these insects. The ranges of the different species are probably the same as the ranges of plants on which they feed, though in many cases plants of commercial importance have been transported from one section to another without their scales, and are now growing without scale attack, but this does not mean that the scales would not live in these localities if they happened to get there, but only that so far, the transporting of the insects has not taken place.

Although there are ~~sixteen~~ seventeen species of the genus Lepidosaphes found within the geographical limits dealt with in this paper, only three are of any great economic importance. These are the Purple Scale, L. beckii, a rather serious pest on the orange and other citrus fruits; Glover's Scale, L. gloverii, another citrus fruit enemy, and the Oyster-shell Scale, L. ulmi, which attacks a number

of different trees and shrubs, but which is chiefly injurious to apple, ash and poplar trees.

The data in regard to the enemies of the species in this genus are rather meager, while it is probable that most of the species have enemies of one kind or another, only three species have been reported as subject to the attacks of enemies. L. beckii is attacked by three fungi, the Read-headed Fungus, Sphaerostilbe coccophila; Black-headed Fungus, Myriangium duriaei, and White-headed Fungus, Ophionectria coccicola; by one Chalcid, Aphycus flavus, and by a mite, Tyroglyphus gloverii. L. gloverii is attacked by the same fungi as L. beckii, by the Chalcids, Aphelinus aspidioticola, A. fuscipennis, Signophora flavopalliata and S. occidentalis, and by a mite, Oribates aspidioti; while L. ulmi is attacked by the Coccinellid, Chilocorus bivulnerus, by the Chalcids, Aphelinus mytilaspidis and Chiloneurus diaspidinarum, and by the mite Tyroglyphus malus.

Lepidosaphes ulmi,

The typical species, passes the winter in the egg stage and the young after hatching in the spring move around until they find a convenient place to settle down. The long sucking tube is thrust into the tissues of the plant and the insect begins feeding. At the same time it spins fine, cottony threads which fuse to form a scale-like covering over it. After some little time the insect molts, the skin splits just in front of the proboscis on the ventral side and the forward portion is lifted off the head like a cap,

while the remaining portion of the ventral side bearing the rostral apparatus and the legs, is pushed to the rear. After molting, the entire exuvia or cast skin goes to form part of the scale which is increased in size to accomodate the increase in size of the insect, which from this first molt does not possess legs. The second molt which is the last, takes place some time later in a similar manner to the first and the insect is in its last instar. After fertilization, the eggs are laid in the space under the scale, behind the insect, which finally dies and dries up.

The male insect does not differ at first from the female. The first molt is accomplished in the same manner as the first molt of the female and the exuvia forms part of the scale in the same way, but the second and third exuviae are pushed out of the posterior extremity and discarded, the third molt giving rise to the pupa. The second instar differs slightly from the female. In the third or pupal stage the mouth parts have entirely disappeared, but the wings, antennae and legs may be distinguished in their sheaths. After shedding the pupal skin the male remains some time under the scale, finally lifting the posterior portion of the scale and emerging as the winged adult.

The number of broods varies somewhat with the section. Some forms are oviparous and others are viviparous, in which case the winter would probably be passed as partially grown individuals, in place of in the egg stage.

"Male-- Length of body, 0.022 inch; color, translucent carneous-gray; a dorsal transverse band on each abdominal joint, and portions of the mesothorax and metathorax darker, or purple gray; the members somewhat lighter. Head, sub-triangular; rostrum rudimentary; ocular tubercles, one each side of it, plainly visible, the eyes on the upper surface prominent, dark, and with few facets; antennae as long as body, 10-jointed, jts. 1 and 2 bulbous and sometimes indistinctly separated; 3--9 about four times as long as wide, slightly constricted; 10 half as long and fusiform; all but basal two with a whorl of about eight hairs, slightly clavate and as long as width of joint. Thorax very large, oval; prothoracic portion narrowing in front, composed to two transverse folds, the anterior one having a transverse row of four dusky dots; the mesothoracic portion large and elevated, showing three lateral swellings; a well-defined medio-dorsal plate, rounded in front, shallowly notched behind, with a medio-longitudinal suture, and a transverse one dividing it in two, the anterior half pale, the posterior darker; the metathoracic portion showing a sub-triangular scutel, and separated from meso-thorax by the transverse band (apodema of Targioni). Wings about as long as body, arising from base of mesothorax, spatulate, closing flat on back in repose, and appearing whitish, finely and uniformly covered with short, stiff hairs; supported by a bifurate vein, the bifuration arising from basal fourth, and each fork running near and almost parallel with the wing-margins; balancers dark, with the

hook quite long. Legs with the middle pair longest, and-- from large size of coxae-- further from front than from hind pair; the coxae and femora large and swollen, the latter with a more or less distinct lobe near the base below; the tarsi one-jointed, with a constriction occasionally indicated, and terminating in a single flexible claw, surrounded by four clubbed hairs; the tibiae and tarsi are quite bristly, but on the femora there are usually but two bristles, one about the middle above, and one on the basal lobe below; the coxae also have one above. Abdomen, seen from above, nearly as long as thorax; appearing shorter from below; 8 joints only discerned; the last joint abruptly narrowed into a large tubercle bearing four bristles on the under side, and sending forth the genital armor in the form of an awl-shaped style as long as the abdomen."

It was not possible for the author to make a description of the adult male, as no specimens could be obtained, and for this reason the description made by Riley is appended, as being the best so far published.

DESCRIPTIONS OF SPECIES.

Lepidosaphes alba. The female scale is slightly over 2 mm. in length, rather narrow, often somewhat curved and strongly convex; the color is sordid white. The exuviae are placed at the anterior end, both are bright yellow; the first is small, oval and naked; the second is much larger, oval and covered by a film of secretion.

The ventral scale is well developed and adheres to the dorsal scale along the lateral margin, leaving the narrow median portion attached to the bark.

The female insect is strongly mytiliform, being much narrowed anteriorly. The divisions between the various segments are only faintly marked and the outer ends of the free abdominal segments project only very slightly beyond the rest of the margin.

Characters of the pygidium. There are three pairs of lobes on the posterior margin; the median pair are faintly trilobed on the ends, wide, broadly rounded at the ends and widely separated; the second pair are shorter, pointed, and strongly bilobed with the inner lobule twice as wide as the outer one and much longer; the third pair is trilobed, the inner and outer lobules about one-half the width of the middle one, short and pointed; the middle loblue is short, broadly rounded and somewhat shorter than the other two. Beyond the third lobes, the margin is broken up by small projections and indentations. Between the median lobes there is a pair of long, stout gland spines placed close to the bases of the

lobes and at the margin, while just inside and nearer together than the gland spines, is a small pair of simple spines. There is one pair of gland spines beyond the median lobes and one pair beyond the second lobe, all of which are about the same length as the median pair.

The short dorsal tubular spinnerets are scattered irregularly over the pygidium and most of them are on a line with the anal orifice which is in the middle of the pygidium. There are no circumgenital glands.

The male scale is nearly 1 mm. in length and is nearly oblong, with the yellow exuvia at the pointed end. It is of a sordid white color and the ventral scale is strongly developed and adheres completely to the dorsal scale.

This species has been collected in Cuba, Jamaica, Bahama, Bermuda, Mexico, California, New Mexico, and Florida.

So far, it has been noted as feeding on Solanum and Manihot, both plants of the family Malvaceae, and on Cassava.

Bibliography L. cockerelliana Kirk., The Entomologist, 37, p. 257 (1904).

L. argentata. "Female scale about 2 1/2 mm. long, often curved, very narrow, linear in fact, but covered and broadly margined with a film of semi-transparent silvery secretion, which under the microscope, has a reticulated structure, resembling a skeletonised leaf. The scale itself is dark brown; the exuviae are dull orange.

Male scale white; short and broader, with its filmy margin broad enough to be called oval, or sometimes subcircular, with the orange exuvia projecting at the anterior end. The male and female scales congregate in large patches on the leaf, and even the area between them is thinly covered with the silvery secretion.

Female very long and narrow, dark red, with the caudal portion yellowish; when boiled in liquor potassae becoming dull yellowish, the caudal portion nearly colorless. The body is chitinous, except the caudal and cephalic parts. Sides of segments not protruding, the lateral margins straight, except that just before the caudal portion there is on each side a strong process, like the end of a finger, directed backwards. This process is sometimes long, sometimes quite short, and just before it is a rudimentary second process. No groups of circumgenital glands, but a conspicuous row of transverse glands parallel with the margin, as in M. melaleucae, but not so near the margin. Four almost colorless lobes, and many pointed processes of the margin. The median lobes resemble human incisor teeth, but are shorter, they are upright,

well apart, with a spine-like gland-hair in the interval. Beyond each median lobe, not touching it, is a large pointed process of the margin, just beyond which is the second lobe, which is shaped like a cone lying on its side, the apex adjacent to the apex of the pointed process just mentioned. Next comes a wide interval, with three small spine-like gland-hairs; then a second large pointed process, resembling the first; after which the margin is coarsely serrate with four or five pointed processes, directed caudad. Cephalic end smooth.

Embryonic larva (in body of female) with rostral filaments in two coils. Two large figure-of-eight glands in the cephalic region.

Hab.-- On upper side of large ovate-lanceolate leaves of a forest tree; Campinas, Brazil. (F. Noack, n. 12 .) A very distinct species; by its narrow scale with a colorless border it resembles M. pallida Green, from Ceylon.

Mesilla Park, New Mexico, U. S. A., June 8, 1898."

From Revista do Museu Paulista, Vol. III, p. 43, 1898.

L. beckii. The scale of the female is nearly 3 mm. long, strongly mytiliform, more or less curved, moderately convex, and dark brown in color. The exuviae are dark yellow. The ventral scale is well developed and adheres to the dorsal scale, with the exception of a small piece posteriorly.

The female insect is strongly mytiliform and it is widest at the free abdominal segments, the lines of segmentation are distinct only between the free abdominal segments, the ends of these segments project strongly beyond the rest of the margin.

Characters of the pygidium. There are two pairs of lobes, the median lobes are broad, somewhat pointed, minutely serrate and widely separate; the second lobes are bilobed, the inner lobule wider and longer than the outer and both lobules pointed. There are nine pairs of gland spines, one rather short pair between the median lobes, a pair beyond the median and three pairs beyond the second lobe, set at equal distances from each other. The dorsal tubular spinnerets are short and arranged in regular rows. There are five groups of circumgenital glands, the anterior group consists of about eight, the anterior laterals of about fifteen, and the posterior laterals of about ten. The anal orifice is near the base of the pygidium. It is small and circular.

The male scale is slightly over 1 mm. long, nearly oblong, dark brown, and the ventral scale adheres entirely to the dorsal.

Collected in West Indies, Bermuda, Florida, Louisiana,

Colorado, California, Connecticut, Wisconsin, Maderia, W. Africa, S. Africa, Mauritus, Ceylon, Japan, Fiji, Australia, Tasmania, New Zealand and Hawaiian Islands.

On orange, lemon, citron, fig, croton, grape fruit, eleagnus, oak, Fraxinus cuspidata, Banksiae integrifolia, Cercidiphyllum japonocum, Pomaderrio apetala.

Bibliography L. beckii Austran. Las Cochinillas Argentinas, p. 24 (1907).

L. carinata.

"Female Scale.--- 3 1/4 mm. long; second skin about 1 mm., first skin about one-half mm., about one-half on first. Width of scale three-fourths mm. Scale very pale brown, strongly keeled, almost exactly straight, narrow, not shining, exuviae dull orange. Male scale similar but smaller, with only one pellicle.

Adult male.-- Ordinary, well winged.

Adult female (in caustic soda).-- Of the ordinary shape, pale yellow. Groups of ventral glands nearly obsolete, but in one example the cephalolateral group, of 4 orifices, is distinct; and the caudolateral, also of 4, is imperfectly developed. There are rows of well-marked elongate pores marking the obsolete segments. Anal orifice a long distance from hind end. Three pairs of lobes, all very small, narrow, and inconspicuous, the median largest,

shaped something like a blunt canine tooth, widely separated, with a pair of spine-like plates between. Outside each median lobe is a long spine-like plate, much longer than the lobe, then a short one, then a slight projection; then the third and second lobes, close together but not touching, of about the same size, and nearly of the shape of the median lobes; then comes a raised portion, gradually sloping, and exhibiting four or five marginal sacs of no great length; then a notch and two very large spine-like plates, then after a short interval a notch marked by a pair of marginal sacs, then after a rather long interval another notch and pair of sacs, then shortly after another pair of very large spine-like plates, then after a rather long interval a notch and pair of sacs, then after a somewhat longer interval a couple of notches, then a large spine-like plate, then a notch, then a large spine-like plate. The notches might as well be described as serrations.

Habitat.-- Found by Mr. Alex. Craw in his quarantine work, October 26, 1895, "upon plants like Anthurium arrived from Central America." It occurs on the leaves, in moderate numbers, scattered. It has a certain superficial resemblance to M. citricola, but differs at once by the narrower, keeled scale."

From Bulletin 4, Technical Series, U. S. Bureau of Entomology, p 45, 1896. Described by Cockerell.

L. chilopsidis. "Scale of female: More than a millimeter in length, narrow, light purplish in color.

Scale of male: Similar, about one-half the size of the female.

Adult female: A little more than a millimeter long, of normal Chionaspis shape, expanding notably posteriorly; anterior and lateral margins smooth, normal. Anal plate much broader than long, and but slightly chitinized. Lobes limited to one prominent median pair. Laterals obsolete or represented by slight tooth-like projections. Margin of pygidium somewhat toothed, caused by the pro- over each of the large marginal oval pores. Incisions inconspicuous; paraphyses wanting. Plates: 2 median followed on either side by a group of 4 or 5, then 2 or 3; plates somewhat longer than lobes. Spines normal; anal opening very near base of segment. Paragenitals: Anterior 5; anterior laterals 7 to 10; posterior laterals 7 to 9 (from examination of two females). Large marginal pores occurring in three pairs, two each, with a single pair near the base of the segment. Large scattering circular or slightly oval pores over the general area of the pygidium. Basal thickenings wanting; ventral thickenings limited to a slightly chitinized band about twice the width of the median lobes, extending slightly beyond the anal opening.

Type. -- Bureau of Entomology No. 7218. Scatteringly infesting a small section of a plant doubtfully identified as Chilopsis linearis; collected by C. H. T. Townsend in Tehuantepec City, Mexico, May 26, 1896.

Note-- the females of this insect were gravid with young at time of collection. The distinguishing feature is the absence of the lateral lobes in connection with the rather large prominent median pair."

From Bulletin 16, Part II, Technical Series, U. S. Bureau of Entomology, p. 27, 1908. Described by Marlatt.

L. concolor. The female scale is nearly two mm. long, strongly mytiliform, rather narrow, strongly convex, white with the exuviae light yellow. The ventral scale is strongly developed and adheres completely to the dorsal scale, with the exception of a small portion at the posterior extremity. The female insect is strongly mytiliform, the segmentation is only faintly marked and the ends of the free abdominal segments only project very slightly beyond the rest of the margin.

Characters of the pygidium. There are three pairs of lobes, the lobes of the median pair are strongly developed, widely separate and faintly trilobed at the extremity; the second pair is short, bilobed, both lobules pointed, with the inner lobule longer and wider than the outer; the third pair is very short, bilobed, with the lobules about equal in size and pointed. Beyond the third lobes the margin is broken up by small projections and indentations.

There is a pair of gland spines between the median lobes, a pair beyond the median lobes, another beyond the second lobes, and three single ones on the margin beyond the third lobes.

The dorsal tubular spinnerets are regular. The circumgenital

glands are not arranged in regular rows but are scattered over the pygidium, though sometimes they may be placed in groups of three or four. The anal orifice is large, circular and situated near the base of the pygidium.

The male scale is about 1 mm. long, nearly oblong, white with the exuvia light yellow and the ventral scale adheres completely to the dorsal scale.

Collected in New Mexico.

On Chenopodium and Atriplex canescens.

L. concolor viridissima. According to Cockerell and Parrott this variety only differs from the species by the color of its scale which is bright green. It is found on the same plants as concolor and was collected in the same locality.

L. crawii. "Female scale.-- Narrow, about 2 1/3 mm. long and one-half mm. wide, slightly curved, pale orange yellow, exuviae concolorous.

Adult female.-- Yellow. Four groups of ventral glands, caudolaterals of 3, cephalolaterals of 4 in a row. Median lobes very large, rounded at ends, their edges finely serrate. They are closely adjacent at a point at the base, being separated, however, by a pair of small spine-like plates; thence they diverge at nearly a right angle to their rounded ends, thence rapidly sloping, the outward slope longer than the inner, and diverging from it at an

angle of about 80°. Next to the outer side of each median lobe is a small spine-like plate, then a sac-like incision, then the small second lobe, shaped much like the last joint of a finger and in bulk hardly one-tenth of a median lobe. Following this is a small sac-like incision, then a pointed projection, then two saccular incisions, then after a short interval a spine-like plate, then another sac-like incision, then a long interval of smooth margin, then another sac, then another interval, in the middle of which is a small spine. Below the sac-like incisions are transversely elongate pores.

Habitat.-- Japan. Found by Mr. Craw in the course of his quarantine work, on leaves of Elaeagnus from Japan. I do not know the species of Elaeagnus, but the leaves are about 3 inches long and 1 3/8 inches broad. The scale is extremely inconspicuous, as it lives beneath the epidermis on the underside of the leaf along the midrib. By this habit and the large median lobes it will be readily distinguished. From Mytilaspis grandilobis Mask., which has the large median lobes, it is known by the entirely different color of the scale, etc. Several of the specimens were parasitised."

From Bulletin 4, Technical Series, U. S. Department of Agriculture, Bureau of Entomology, p. 44, 1896. Described by Cockerell.

Collected in California.

On Croton.

L. crotonis. "The scale is about the shape and size of M. pomorum; some show holes through which a parasite has escaped.

The very young larva is active, pale purplish with yellow extremities. The caudal filaments are about as long as the greatest diameter of the body, but they are easily broken off. Between the tubercles, which bear the long filaments, are two small but distinct tubercles, each bearing two very short bristles. Along the margin, immediately external to the filament-bearing tubercle, is on each side a pair of bristles of fair length. Beyond (anterior to) these is another shorter pair, and further still two more pairs, which are very short and not conspicuous. On the sides of the thoracic region are one or two short hairs. On the margin, anterior to each antenna, is a blunt tubercle, and the anterior cephalic margin presents three pairs of hairs, the middle pair strongest, the outermost pair rudimentary or almost obsolete. The last joint of the antenna presents three or four short but strong hairs. The general form of the larva is oval. The leg shows a claw apparently without digitules, but the tarsus has stout clubbed hairs, longer than the claw. In color these larvae resemble those of M. gloveri, as described by Comstock.

The adult female, as usual in the genus, is elongate. The terminal portions are yellow shading into orange. The lobes are much as in other members of the genus: median lobes separate, well-developed, trilobed; next pair bifid, and smaller; third pair

practically obsolete, but two distinct notched projections beyond them.

The really extraordinary character of the adult female is in the spinous plates, which are prolonged into long hairs, after the manner of Aspidiotus chamaeropsis, as figured by Signoret. This distinguishes the species at once, but with rough handling the hairs are easily broken off, leaving an appearance like the ordinary spinous plates.

Bright orange mites are common among the scales, and seem to prey upon them. I found one mite inside a female scale, half concealed beneath the body of the female; another actually had hold of a larva. The anterior legs of these mites emit two very long hairs, a character which may perhaps serve to distinguish them."

From The Entomologist's Monthly Magazine, Vol. XXIX, p. 156, 1893. Described by Cockerell.

Collected in Jamaica.

On Croton.

L. flava. "The scale of the female entirely resembles that of ulmi; only it is more straight and is covered with a grayish powder which makes the insect confused with the bark of the tree.

The female, the same as ulmi, has the segments more generally pronounced. The last segment has five groups of circumgenital glands of which the anterior is of 3 orifices, the anterior laterals of 6 to 8 and the posterior laterals of 6 to 7, the border shows

two large median lobes and at each end are seen 6 to 7 large spines. The three last segments have two or three spines on the lateral lobes.

Scale of the male smaller, clearer, nearly yellow.

Collected in Europe, Australia, N. Zealand, N. America.

On olive."

Translated from Signoret's description in Annales de la Société Entomologique de France (4), X, p. 96 (1870).

L. gloverii. The scale of the female is between 2.5 and 3 mm. in length, narrow with nearly parallel sides, moderately convex, light brown in color with the exuviae light yellow. The ventral scale is well developed and adheres to the dorsal scale with the exception of a narrow portion through the middle and a small posterior portion.

The female is elongate with straight sides which converge anteriorly, the segments are fairly well marked, especially the free abdominal ones, the last three of which have their outer ends projecting considerably beyond the rest of the margin and bearing several long stout spines.

Characters of the pygidium. There are two pairs of lobes on the posterior margin, the lobes of the median pair are widely separate, broad and are faintly trilobed at the tips; the second lobes are bilobed and are about the same width as the medians, the lobules are equal in width and somewhat pointed. There are nine

pairs of long stout gland spines placed as follows, one pair between the median lobes, a pair beyond the median lobes, another beyond the second lobes and two more on the margin, beyond which is marked by various small projections. The dorsal tubular spinnerets are in regular rows; the circumgenital glands are in five groups, the median group consists of about 4, the anterior laterals of about 7 and the posterior laterals of about 5. The anal orifice is small, circular and is placed close to the base of the pygidium.

The male scale is about 1.5 mm. in length, nearly oblong, pale yellowish brown in color, with the margin whitish and the exuvia pale yellow; the ventral scale is strongly developed and adheres completely to the dorsal scale.

Collected in Cuba, Barbados, St.Kitts, Trinidad, Mexico, Middle and Southern States, California, Australia, India, China, Japan, Mauritius, Cape Colony, Hawaiian Islands.

On orange, lime, palms, tangerine, croton, Magnolia fuscata, Cordylius dracaena.

L. mexicana. "Female.-- Scale pale brown dull, flat, so broad as to be almost circular, the pointed basal end sometimes curved to one side. Diam. 3 mm., length 3 1/3 mm. Exuviae brown, of a darker tint than the scale, second skin covered.

Female.-- After boiling colorless, the caudal portion strongly striated longitudinally, and suffused with yellow. Median lobes large, a short distance apart, the inner margins parallel, the apex rounded, the outer declivity long and twice notched; second lobes

small, completely divided into two lobules, of which the outer is the smaller; third lobe similar, but only one distinct lobule; beyond the third lobe are three broad serrated eminences, representing rudimentary lobes; plates spine-like, stout, and rather long; many transversely linear dorsal glands; some structures like the interlobular thickenings of Diaspidiotus, but below instead of between the lobes. Five groups of circumgenital glands, median of 18 to 25, anterior laterals about 27 to 33, posterior laterals 25 to 35.

Male.-- Scale elongate, of the form usual in the genus.

Hab.-- Cuautla, Mexico, on "Nettle-tree," July 2, 1897 (Koebele, 1724). Div.Ent. 1763. Also collected by Koebele at Cuautla on "Dragon's Blood" (?) and on roots of Ficus, sp. (?), many of the last-mentioned lot being parasitized.

The form and appearance of the scale at once distinguish this from all other American forms.

In the collection are also specimens of Mytilaspis (subg. Opuntiaspis, Ckll., MS.) philococcus, Ckll., marked "On cactus, Mexico, Aug. 2, 1897" (Koebele, 1695). Div. Ent. 5860."

From Annals and Magazine of Natural History (7), 1, p. 438 (1898). Described by Cockerell.

L. mimosarum Ckll. "Female. Scale 2 to 3 mm. long, brownish white, narrow, convex, usuually curved; exuviae orange-brown. Male scale as usual. Compared with the next species (L. townsendiana)

the scales are larger, and not so pure white.

Female. Adult. Colour (after boiling in KHO) greenish or pale orange, the anterior end sometimes slightly pinkish. Five groups of circumgenital glands; median of 9, anterior laterals 16 to 18, posterior laterals 9 to 10. Only one pair of distinct lobes, these large and brownish, rounded, slightly crenulated or entire, separated by an interval in which are two pointed squames. A pair of pyriform glands at the base of each median lobe, but quite at the lateral margins, though the outer one is curved inwards; the second lobe represented by two colourless minute lobules, the inner one the larger; after this come a spine and a pair of large spine-like squames; then two broad and very low eminences representing the third lobe, the second usually minutely crenulate; then a spine and two very large spine-like squames; then after a considerable interval two or three more spine-like squames, and three such on the lateral margins of each of the next three segments. None of the segments have their lateral margins noticeably produced. Submarginal transverse glands as usual; dorsal glands as usual, not especially numerous. Anal orifice about opposite the median group of circumgenital glands, and 138μ distant from tips of median lobes. Skin minutely striated throughout. Length of the longest squames, 24μ .

Female. Second stage. Colour (after boiling) pale yellowish brown; one pair of large low lobes; large squames.

Larva.-- Rather elongate; colour (after boiling) pale greenish,

with usually a large brown spot in the region of the mouth; eyes blue; spines large; the two caudal lobes look like long-fanged incisor teeth, but only project above the margin as two very minute nodules.

Hab. Zapotlan, Mexico; crowded on small branches of Mimosa sp., July 6th (C. H. T. Townsend)."

From The Entomologist, Vol. XXVI, p. 45 (1903).

L. nigra Ckll. "Female. Scale 3 1/2 millim. long (exuviae 1 1/3 millim.), pitch-black, with a narrow dull white margin; very narrow, very convex in a transverse direction, with a dorsal keel; exuviae elongated, half of first skin on second, first skin dull orange, second skin dull dark reddish-brown.

Female. Greatly elongated, yellow, parts turning green in caustic soda; circumgenital glands present, caudolaterals of three, cephalolaterals about four, median doubtful (absent?). Two pairs of well-formed lobes, not particularly large, rounded at ends, with minute lateral lobules; a separate rounded lobule of fair size just laterad of the second lobe. First interlobular interval wide, occupied by an obliquely-placed transversely elongated gland; other such glands are conspicuous along the margin beyond the lobes. Margin beyond the lobes very coarsely and irregularly serrate, with some rather large spines. Cephalic end without spines.

Embryo in female large, with dark blue eyes and 6-segmented antennae.

Larval antennae with segments measuring thus in μ :-- (1) 11,

(2) 7, (3) 11, (4) 7, (5) 9, (6) 26.

Hab. Mexico: Coatzocoalcos in Vera Cruz, April 24, 1898, on leaf of a large tree called "laurel" (Townsend). "

From Biol. Centr.-Amer., Vol. II, Pt. 2, p. 32 (1899).

L. philococcus Ckll. "Scale of the female about 4 mm.long and 2 mm. broad; mytiliform but scarcely inequilateral; of a sordid white color with a distinct longitudinal carina. Exuviae at one of the extremities, naked, of a pale brown color; skin of the first molt about (or scarcely) one-half as long as that of the second and passing the anterior border of that. Skin of the second molt not ribbed, rather long, length about 1 mm. The two exuviae are carinated.

This description applies to the scale in the natural state, the white color is due to a secretion. The true scale is over 1 mm. in length, straight, has the sides parallel and is black but is covered with a white secretion which extends beyond its edge.

Female after boiling. Elongate, of a very pale brown color, skin finely striated; ends entire, without prolongations; segments indistinct; rostral filaments forming a loop of unusual brevity; ends of the body with groups of large glands separate one from the other; the rows of these glands mark the obsolete segments of the terminal portion which is yellowish. The lobes and plates are as in Fig. 2: the median lobes are slightly prominent, entire, rounded,much separated one from the other; between them are two large spiniform plates longer than the lobes. Following each median lobe one sees a

large spiniform plate, then three little lobes (representing the division of the second lobe of the other species) of which the first is the smallest; then a large spiniform plate; then two little lobes, the first presenting two notches, the second one notch; then one very large spiniform plate; then a large flat lobe finely denticulate; then a notched projection; then four spiniform plates; then a little projection; then a large spiniform plate; then a large flat lobe, finely denticulate; then a notched projection, then three spiniform plates.

Egg oval elongate, pale indigo (in KOH); those in which the eyes are visible are of a dark olive brown color. The embryo is yellowish, the shell of the eggs is indigo blue. The eggs which present the same color are only empty shells.

The male scale. Unfortunately I know nothing positive about the male. I believe I am able to report for the male a fragment of a white scale with a carina small or absent (as in the Diaspis) with the orange brown exuvia at one of the extremities.

Collected in Mexico.

On Cactus, Agave yucca, Cereus germinatus."

Translated from Bull. Soc. Zool. Fr., XVIII, p. 252 (1893).

L. pinnaeformis Newstead. "Puparium of adult female yellowish brown to dusky brown, or greyish ochreous, paler at the margins; edges of laminae frequently white; sometimes the whole puparium is faintly farinose; convex, straight, curved, or mytiliform. Larval

exuviae dull yellow to orange-brown; second exuviae usually of the same colour. Ventral scale complete, usually comes away unbroken. Form not differing materially from M. pomorum, but I have never seen the colour so dark as in this latter.

Long. 1.75--2 mm.

Adult female (Pl. XXV, fig. 1C) white or yellowish. Very elongate, narrowest in front, widest at first free abdominal segment. Rudimentary antennae with one or two stout, curved hairs. Anterior parastigmatic glands very from 6 to 9; posterior groups absent, but a little posterior to the spiracle is a group of 3--4. Four free abdominal segments very pronounced, forming, after treatment with potash, tuberculate projections, each furnished with several short spines. Dermis with tubular spinnerets as in M. pomorum. Pygidium (Pl. XXVI, fig. 1; Pl. XXVII, fig. 4) with five groups of circumgenital glands; anterior group arranged in a single concave series; anterior laterals usually forming a pyriform group; posterior laterals usually in a more or less circular group.

Anus considerably above anterior grouped glands. Vaginal opening immediately below the posterior lateral groups. Subdorsal groups of tubular spinnerets occupying same position as in M. pomorum, but shorter and a little more defined. Seven marginal tubular spinnerets on each side of the centre, very large, the first singly between the median and second lobes; the rest in pairs. Median lobes narrower, more attenuated at the base than in M. pomorum;

lateral margins sloping and extending within the body-wall, more irregularly dentate or bluntly serrate; posterior margin lobate; second and third pairs of lobes, placed together, have the posterior margin rounded, and sometimes with a faint lateral notch. Plates, one median and four lateral pairs, are simple and spine-like. Margin between the second and third pairs of lateral plates distinctly but irregularly serrate. First marginal pore with a minute spine-like projection.

Male puparium, usually a little paler than that of the female, is of a more delicate structure than that of M. pomorum. Hinge towards the posterior extremity.

Male unknown.

Habitat.-- First recorded from the Royal Botanic Gardens, Kew, on Cymbidium pendulum, by Mr. Douglas. It is strange that both Bouché and Signoret should have found the insect upon the same genus of plants, as it a lover of Citrus trees, and everywhere they are cultivated the insect seems to become a pest. It also occurs here freely upon imported oranges and lemons."

From A Monograph of the British Coccidae, Vol. I, p. 2C4.

Collected in N. America, Argentinas, England, Australia, N. Zealand, Demerara, Hawaiian Islands.

On Croton.

L. townsendiana Ckll. "Female. Scale 2 mm. long, convex, narrow, often curved; white, with orange-brown exuviae. Male scale

as usual.

Female. Adult. Colour (after boiling in KHC) pale yellowish green; the two segments anterior to the terminal portion much produced at the sides, into rounded lobes directed backwards, these lobes having many round glands. No circumgenital glands, but numerous round, dorsal glands, much as in M. ulmi; a curved band of these glands on each side of the anal orifice, simulating a continuous band of circumgenital glands, but differing by the glands being smaller and not so close together, irregularly placed. Transverse submarginal glands of the usual type. Small pyriform marginal glands of the usual type; two under each median lobe; two under the first (larger) portion of second lobe; the first of these small; two very small ones under the small portion of second lobe; a large one under each half of third lobe; four others under projections of the margin beyond. Spines rather large; squames not large. Lobes striated; median lobes not far apart, large, rounded, and entire; second lobes divided into a large inner and small outer lobule, the inner minutely crenulate on its outer slope; third and fourth lobes each represented by a couple of low crenulated processes, those of the fourth much broadest; one or two pointed processes on the margin beyond. The margin beyond the third lobe might be said to be irregularly serrate. Antennae with two bristles. Anal orifice to tips of median lobes about 114μ; breadth of median lobes about 12μ.

Female. Second stage. Colour (after boiling) pink. Lobes

formed as in adult, but second lobe is low and entire.

Larva.- With two large low lobes, widely separated. Femora swollen.

Hab. Colima, Mexico; abundant on small branches of "garabatillo," July 13th (C. H. T. Townsend). Easily separated from M. alba by the narrower scale and entire median lobes."
From The Entomologist, Vol. XXXVI, p 46.

L. ulmi (L.) The female scale is nearly 3 mm. long, strongly mytiliform, more or less curved, moderately convex and dark brown in color with the exuviae orange yellow; the ventral scale is well developed and remains attached to the dorsal scale along the sides and the anterior portion.

The female insect is nearly oblong with the anterior margin truncate and with the segments, especially the free abdominal segments, well marked; the ends of the free abdominal segments project only a very small distance beyond the rest of the margin and the last three segments have a few small spines on these ends.

Characters of the pygidium. There are two pairs of lobes on the posterior margin, the median pair is short, broadly rounded and set far apart; the second lobes are short and bilobed, with the inner lobule the larger and with both somewhat pointed. Beyond the lobes the margin is broken up by numerous small indentations and projections. A pair of rather long stout gland spines between the median lobes, another pair beyond the median lobes and seven more on the margin beyond the second lobe, five of them being rather

close together and near the second lobe, while the other two are further along the margin. The dorsal tubular spinnerets are arranged in regular rows. The circumgenital glands are in five groups, the median group consists of about 11, the anterior laterals of about 20 and the posterior laterals of about 12.

The anal orifice is rather small, circular and near the base of the pygidium.

The male scale is only about 1 mm. long, somewhat mytiliform, dark brown with the exuvia orange brown. The ventral scale is well developed and adheres completely to the dorsal scale.

Collected in North and South America and Europe.

On apple, pear, ash, willow, poplar, lilac, etc. Full list in Circular 121, Bur. Ent., Dep. Ag., 4 (1910).

EXPLANATION OF TERMS.

Anus-- A nearly circular opening on the dorsal surface of the pygidium which varies in position from central to basal.

Circumgenital glands-- Circular glands arranged in groups around the genital orifice that furnish a fine powder which is placed on the eggs as they are laid.

Dorsal tubular spinnerets-- Oval orifices on the dorsal surface of the pygidium whose function is to spin the threads which go to make up the scale.

Exuviae-- The molted larval skins that are used to form part of the scale.

Genital orifice-- Seen as a short, sinuate line in the middle of the pygidium.

Gland-spines-- Spine-like projections from the margin called by various authors plates, squames, etc.

Lobes-- Projections from the posterior margin of the pygidium.

Marginal gland orifices-- Glands similar to the dorsal tubular spinnerets but larger and located along the margin.

Pygidium-- The end piece of the female abdomen composed of several segments fused together to form a shield-shaped piece.

Scale-- The covering that protects the insect, composed partly of exuviae and partly of secretion.

Secretion-- That part of the scale distinct from the exuviae that is formed by the dorsal tubular spinnerets.

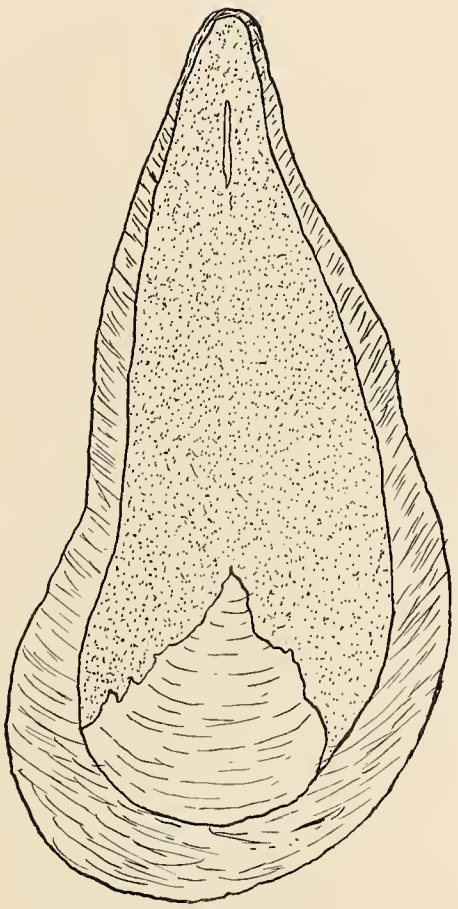
EXPLANATION OF PLATE I

Lepidosaphes beckii

Ventral view of female scale.

Adult female.

Pygidium of adult female.



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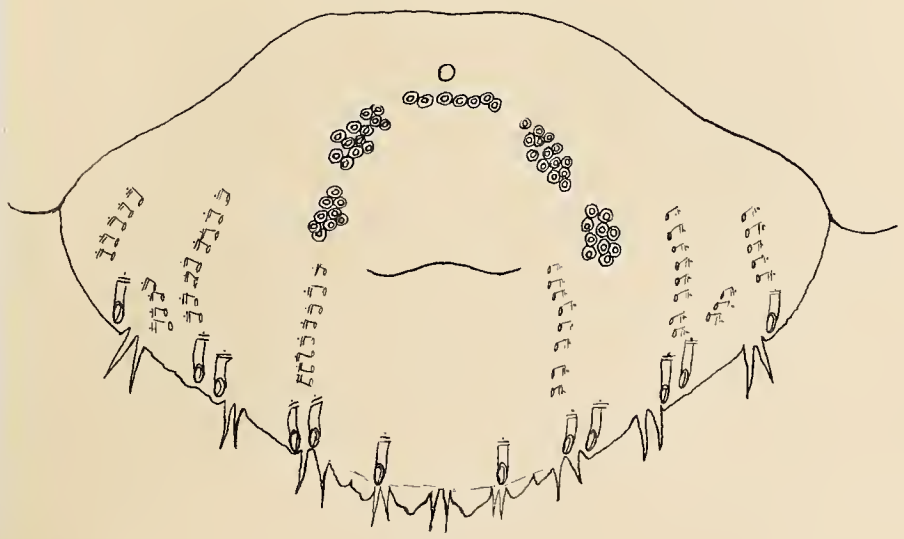

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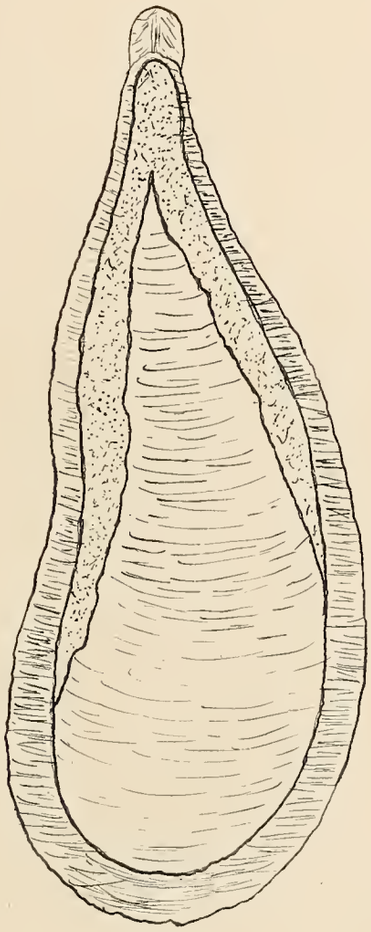
EXPLANATION OF PLATE II

Lepidosaphes gloverii

Ventral view of female scale.

Adult female.

Pygidium of adult female.



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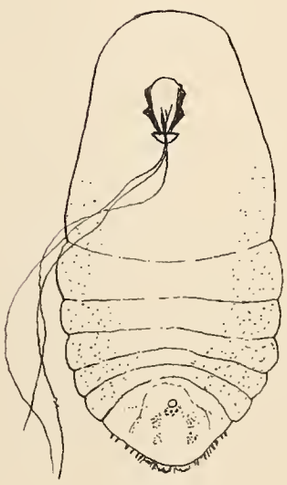

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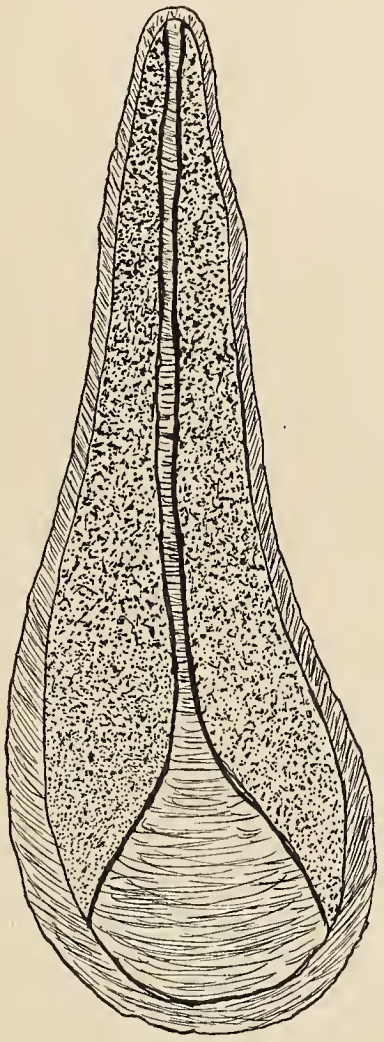

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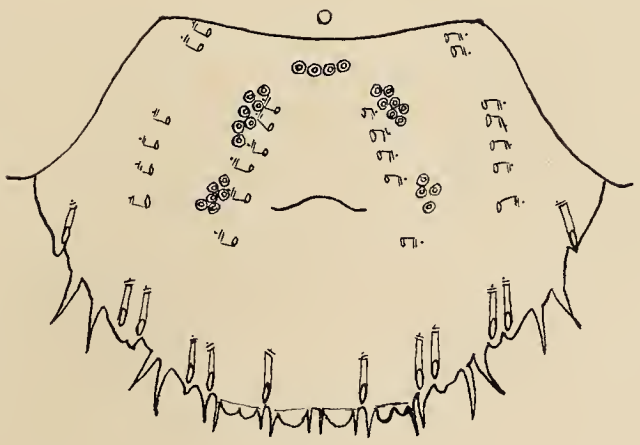

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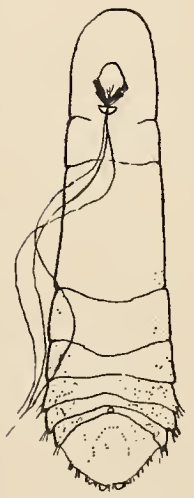

2.

The Early Stages of the Oriental Moth.

By H. T. Fernald and J. N. Summers, Amherst, Mass.

(Plates X, XI.)

The early stages of the Oriental Moth, *Cnidocampa flavescens* (Walk.), have never been described and several attempts to obtain fertile eggs from the moths in captivity have failed. This has been supposed to be because the small space provided by a breeding cage either prevented mating, or because the confinement in some way affected the moths. To avoid such difficulties a large number of the cocoons of this insect obtained at Dorchester last spring were placed in a greenhouse in which several Norway Maples were growing, all openings having been screened with cheese cloth.

The moths began to emerge June 22nd, probably rather earlier than would usually be the case in the field and certainly two weeks earlier than in Dorchester this year, the season being very late, and the first eggs were observed June 26th. The moths by this time had become very abundant in the house and eggs by the hundred were obtainable by the first of July.

During the day time the moths remain quiet, assuming a most grotesque position. Grasping some object, preferably the edge or petiole of a leaf, with their middle or hind feet they let themselves hang downward till the outer margins of the closed wings come against some object in which position they remain. At night they remain quiet till well after darkness before flying, not being crepuscular. Their flight is quite speedy and produced by very rapid movements of the wings and they are somewhat attracted by light. Their average life seems to be about a week or ten days.

The Egg.—The eggs are deposited on the underside of the leaf, mainly near the margin and preferably toward the apex. They are oval in outline, though sometimes a little irregular, lenticular, one of the surfaces being in contact with the leaf. They are about 1½ to 2 mm. in length by ¾ to 1 mm. in width, transparent, though sometimes showing a faint milky white color. Examination under the microscope shows that the chorion is finely sculptured, irregular polygonal areas being present, the longest diameters of the polygons being more or less at right angles to the long axis of the egg. Scattered over the surface are tiny elevations or papillae averaging about four to each polygon, though many lie on the lines between the polygons. No micropyle was observed.

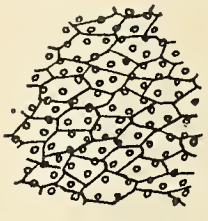

Fig. 1.—Portion of chorion—from camera drawing.

In the later stages the embryo becomes plainly evident and finally escapes through an opening in the side of the chorion after an embryonic life of six or seven days.

First Larval Instar.—The newly-hatched larva measures about 1 mm. at rest and in motion elongates about 1/5 mm., the head being retracted into the second (prothoracic) segment when the larva is quiet. The head and second segment are much narrower than the rest of the body. The body increases in lateral diameter to the middle of the fifth segment, then tapers gradually to the end, which is rounded. Its vertical diameter is also greatest at the fifth segment. Annulations are very indistinct. The color is white and semi-transparent, except for a pale straw tinge, which is seemingly internal in location. A row of sub-dorsal horns and a row of lateral horns is present on each side, the sub-dorsal horns being located, one on each segment from the third to the thirteenth inclusive, while the lateral horns are on the third, fourth and sixth to twelfth segments inclusive. The first three sub-dorsal horns are in length nearly half the diameter of the body, and their

basal diameter about one-third their length. The fourth is rather smaller while the next four are still smaller and shorter. The last three, however, are much larger and increase in size, the last one being fully as large as the first one of the row. Each horn bears two or three black spines on its tip, the larger ones bearing three, and the smaller ones two, usually each spine being nearly as long as the horn on which it is borne. The horns are white with transparent areas. The first two lateral horns are about equal to the sub-dorsal horns of the same segments, in size and appearance, but the next six are rather smaller. The last lateral, however, is large and like the sub-dorsal of that segment. The larger of these horns bear three black terminal spines, while the smaller ones seem in some cases to bear but two, though the exact number could not always be determined. The color of the lateral horns is like that of the sub-dorsal ones. An evident depression along the mid-dorsal line is present. Color beneath like that above. Legs not distinguishable. Duration of instar, about three days.

Blackish streaks appear in the horns at the base of the spines toward the end of the instar—possibly the spines of the following instar.

Second Larval Instar.—Length 1 4/5 to 2 mm. at rest; about 2 2/5 mm. when in motion. Annulations of the body more pronounced. General color yellowish white, but there is a dark spot on each side of the head, the mouth parts are dark and the clypeal region is brownish.

Mandibles brown on edges, four-toothed. Maxillae showing two teeth or lobes. Viewed from beneath a cresentic lobe lies just above the mouth, bearing a number of hairs.

Antennae of three segments and a terminal bristle. The first three sub-dorsal horns are very large and stout, and bear many spines with black tips. The fourth is very small and bears two small spines. The fifth, sixth, seventh and eighth are larger, about equal in size, and each bears five or six spines. The ninth and tenth are much larger, equaling the second and third, and with many spines on the outer fourth. The eleventh is like the first, these two being the largest and having scattered spines to their bases. The first lateral horn is of medium size, rather blunt, but little longer than its basal diameter and bearing several terminal spines and a ring (?) of them a little lower. Second lateral very large—as large as the first sub-dorsal—about twice as long as its basal dimeter, and with numerous spines on its tip and sides. The third to eighth lateral horns, inclusive, are about the size of the first, short, stout, with a long spine or two at the tip and a few shorter ones on the sides near the tip. The ninth lateral is about like the eleventh sub-dorsal, but perhaps more slender. The lateral horns of the middle of the body are larger and stouter than the sub-dorsal horns of that region. Skin glistening, and with minute punctures. Heart beating plainly seen, and also dark-colored food in the alimentary canal. Legs very small, but actively used; of the usual structure.

Anal region noticeably punctured and with a few very small hairs between the anus and the lower margin of the eleventh sub-dorsal horns. A few scattered simple spines are present on the sides below the lateral horns. Duration of instar, four to five days.

Third Larval Instar.—Length, at rest, 3½ to 4 mm.; in motion, about ½ mm. greater. Head and body much as in the previous instar. Color deeper yellow. First sub-dorsal horn about 4/5 mm. long, nearly twice as long as the second and third. Fourth to eighth inclusive very short; ninth and tenth longer; eleventh nearly as long as the first. First lateral, short; second, about like the first sub-dorsal, third to seventh inclusive, very short; eighth longer; ninth nearly as long as the last sub-dorsal. The spines near the bases of the horns are shorter than those nearer the tips. Duration of instar 4½ to 5½ days.

Fourth Larval Instar.—Length at rest about 6 mm.; in motion, about 7¼ mm. Annulations of the body are now well pronounced. Sides of head darker than hitherto, with a median lighter area. General color greenish yellow. Along the mid-dorsal line is a white band extending from the sixth to tenth segments inclusive, external to which is a green stripe reaching from the fourth to the tenth segments. Between the bases of the sub-dorsal horns is an opaque yellow band, and between these and the lateral horns is a white longitudinal stripe.

The horns themselves appear to differ little from their condition in the preceding instar.

Duration of instar, 5 to 6 days.

Fifth Larval Instar.—Length at rest, about 9 mm.; in motion, about 10¼ mm. As in all the preceding instars the color is at first nearly uniform, with only faint traces of the markings which later become more prominent, the spines becoming much darker. General color of the larva when it has become pronounced, pale yellow. The stripes become like those of the last stage, except that the green band is hardly perceptible and the yellow between the sub-dorsal horns is darker. In this instar the fourth sub-dorsal horn is much reduced; the fifth, sixth and seventh are small, but increase in size posteriorly; the eighth is smaller than the seventh, the ninth is three-quarters the size of the first, the tenth much shorter, and the eleventh equal to the first. The first, second, third and ninth grow darker toward their tips. Relative length of the lateral horns as before. Spines somewhat darker after the color has fully developed, than in the previous instar, each now showing two parts plainly; a longer, stout part, and a slender outer end which easily breaks off and causes an irritation worse than that from *Automeris io,* if it touches the skin. These tips vary in length, some being quite long, others short. Duration of instar, 5 to 6 days.

Sixth Larval Instar.—Length at rest, about 12½ mm.; in motion, about 13¾ mm. General color, pale yellow, but with its colored areas much more pronounced than heretofore. Head quite strongly bilobed,

black, mottled with lighter. Antennae darker than before. Second segment with its surface granulated. Cervical shield dark brown, mottled with lighter. A large, dull red area covers the dorsal surface of the third segment behind its spines and the fourth and fifth segments, and extends backward as a wedge-shaped elongation on the mid-dorsal line on to the seventh segment. At the sides this area does not quite reach the lateral horns, and a band between and around the second sub-dorsal horns is yellow, as is also a pair of spots between the third sub-dorsal horns. At the side of the area a triangular blue spot is wedged into the area on a line between the second sub-dorsal and second lateral horns like a similar spot lateral to the third sub-dorsal horn, while a third blue spot, rather oval in outline, rests against the margin of the red area as it begins to narrow posteriorly, just lateral to and in front of the almost obsolete fourth sub-dorsal horn.

In the seventh segment the end of the red area encloses a blue stripe, lighter in the middle, extending into the tenth segment, where it is enclosed by one corner of a rather triangular dull red area which covers a part of the dorsum of that segment and all of the dorsum of the eleventh nearly as far back as the bases of the ninth sub-dorsal horns, and between which the area is slightly extended backward. Lateral to the tenth sub-dorsal horns which arise from yellow areas, the dull red extends backward somewhat, its outer margin in contact with three dull blue spots. From the hinder end of the lateral extensions a faint reddish band crosses the dorsum, completing the enclosure of the two yellow areas from which the ninth sub-dorsal horns arise. These two areas are separated from each other by a median blue spot on the anterior portion of the eleventh segment, from which a blue line passses backward crossed by the faint reddish band, and, in the area between the ninth and tenth sub-dorsals, forms a large spot tinged slightly with reddish. Extending from the blue spot in front of the fourth sub-dorsal horn to that on the tenth segment is a narrow, creamy white band margined on each side by an incomplete green line. A narrow yellowish band extends from the second lateral horn nearly to the posterior end of the body below the spiracles. Annulations of the body well marked. Duration of instar, 5 or 6 days.

Seventh Larval Instar.—Length at rest, about 20 mm.; in motion, about 22½ mm.; greatest diameter, about 11 mm. Head less bilobed than in the preceding instar. The red areas are darker and their outlines have changed somewhat, the anterior one beginning just behind the first sub-dorsal horns and covering the entire dorsum from one row of lateral horns to the other on the third, fourth and fifth segments, except as noted below; narrowing on the sixth to lie between the sub-dorsal horns of that segment, and narowing to a dorsal band on the seventh and eighth segments. On the hinder part of the ninth segment this band becomes somewhat broader, and on the tenth and eleventh

segments it becomes quite broad, constricting, however, to a narrow band again, between the sub-dorsal horns of the eleventh segment, but then enlarging to form an oval spot. Just behind the sub-dorsal horns of the tenth segment a small lateral extension from this dorsal area connects it with an irregular patch of the same color which lies on the tenth, eleventh and twelfth segments between the sub-dorsal and lateral rows of horns. The median area and the lateral patches are so placed with reference to the sub-dorsal horns of the eleventh segment as to leave these arising from the centre of peninsulas of yellow, the isthmus being on the twelfth segment. The dorsal band is interrupted on the eighth and ninth segments by a blue spot on each segment, and there is a blue spot below the dorsal horn on the margin of the red area on segments four, five, six, ten and eleven, and a faint one on the twelfth segment. Anal shield greenish brown, crossed by two light bands. A similar patch occurs just below and lateral to it on each side, crossed by one band. The two fine green lines between the sub-dorsal and lateral rows of horns, described in the last instar, are present, but the creamy stripe they limit is absent.

There is a narrow yellow band between the two second sub-dorsal horns, which encloses their bases and extends a little lateral to them. At the base of each third sub-dorsal horn toward the mid-dorsal line is a yellow spot. In general the yellow color is deeper close to the margins of the red areas.

Fourth sub-dorsal horn very minute and bearing only one spine. The body, as a whole, is noticeably four-sided.

Duration of instar, 5 or 6 days.

Pupation.—The larva changes color somewhat as pupation approaches, the blue and red becoming duller, and the yellow assuming a reddish tinge. After finding a place at which to pupate the larva bites off any loose bark which may be present, smoothing the surface, then spins a loose network of threads around itself and attached to the bark, within which it forms the cocoon.

The threads of the cocoon are attached to the bark and are woven back and forth, the larva moving its head along the lines of a figure 8 from one side to the other. As the threads come closer, the larva seems to secrete a fluid from its mouth which causes the threads just being spun to adhere to those already in place and continuation of the spinning finally produces a solid covering.

During this time the larva contracts as much as possible, drawing its head back into the second segment and is able to move about quite freely within the cocoon.

The cocoon is very light-colored at first, but gradually darkens, hardening at the same time, and assumes the peculiar markings characteristic of this species. As far as outside appearances go, it is completed in two or three hours, and at this time the outer network is often no-

ticeable over the cocoon, somewhat like the network of ropes outside of a balloon. This network soon disappears, however, probably weathering off.

EXPLANATION OF PLATES.

From Photographs by the Senior Author, all but the First Two Much Enlarged.

Fig. 1.—Oriental moth at rest on petiole of maple leaf.
Fig. 2.—Same at rest on tomato leaf.
Fig. 3.—First instar seen from above. Microphotograph. Spines retouched.
Fig. 4.—Second instar from above. Microphotograph.
Fig. 5.—Same in side view. Microphotograph.
Fig. 6.—Third instar from above. Microphotograph.
Fig. 7.—Same from side.
Fig. 8.—Fourth instar, side view.
Fig. 9.—Same, dorsal view.
Fig. 10.—Fifth instar, side view.
Fig. 11.—Sixth instar, side view.
Fig. 12.—Same, dorsal view.
Fig. 13.—Seventh instar, side view.
Fig. 14.—Same, dorsal view.

THE FOOD PLANT OF ENARMONIA TRISTRIGANA, CLEMENS.

BY C. A. FROST, SOUTH FRAMINGHAM, MASS.

WITH DESCRIPTION OF MATURE LARVA BY JOHN N. SUMMERS, MASS. AGRICULTURAL EXPERIMENT STATION, AMHERST, MASS.

This beautiful species of Micro Lepidoptera was first described by Clemens in the Proceedings of the Entomological Society of Philadelphia, vol. v, 1865, and the original description is as follows:

"Fore wings blackish-brown, costa pale-yellow from near the base of the wing to the tip, with eight blackish, oblique streaks and four bluish metallic spots adjoining the yellowish costal stripe. On the middle of the dorsal margin is a large pale-yellow blotch containing three blackish lines, with a bluish metallic spot above it in the middle of the wing, and a semi-band between it and the hinder margin. Hind wings dark brown. Coll. Ent. Soc. Phil.— Va."

Dyar's Catalogue gives the localities of this species as Mass. and Va. Mr. W. D. Kearfott writes me that he has specimens from Anglesea, N. J., May 20th; Essex Co., N. J., May 11th, and July 4th, 7th, and 25th; Newark, N. J., June 1st; and Ashley, Pa., June 24th. He also adds that he has identified specimens from all the New England States and Eastern Canada.

Although the place where this species breeds is one of my favorite collecting grounds, I have never taken a flown specimen of it there and only one elsewhere.

My attention was first called to the work of this species by the dying bunches of *Baptisia tinctoria* which is very common in some localities near here. There seemed to be no healthy plants and an examination showed that nearly every stalk, except some of the smaller ones, was occupied by one or more whitish larvae which had eaten out the inside and left the space filled with a fine debris that resembled sawdust very closely.

The beginning of the burrow seemed to be either on the branches at some distance from the main stem, or, more often, at the point where it joins the stem, and always on the under side. The entrance is marked by a tiny black scar which is sometimes hidden by the leaf, or stipule scar, at the base of the branch. Further investigations show that there are other apparent entrances or exits on the larger stalks sometimes covered by a dead leaf held by silk. These are quite large and I am unable to account for them, assuming that they are made by the larva of the moth, unless they are used for the ejection of debris or as an exit for the imago.

The stem is also eaten out above the highest visible indications of an entrance and in many cases the branches are also mined for some distance. Examinations made August 26th and September 8th showed that the stems are hollow and that the larvae feed on the whitish inner layer which resembles pith; at intervals pits, or enlargements of the gallery, are excavated to the tough outer fibres, while in many instances the inside is eaten entirely away. There are holes eaten through to the outside at some of these places. In some of the larger stems there will be scarcely a trace of a larva for several inches, and then for some distance it will be tightly packed with sawdust. Many times a larva will be found in this sawdust and another larger larva at the base of the stalk below another plug of debris. In one of the large stems five larvae were found and in most cases there were at least two larvae. Many of the larger larvae have the abdominal segments stained a delicate orange-pink on the dorsum. The larvae at this time were about 9 mm. long and spun a thread when crawling.

On November 5th the larvae were found, sometimes one, again two, at the base of the stalk just above where the new buds have already started. They were enveloped in a flimsy cocoon of silk and sawdust with the larva head up. The stalks were dug up, cutting of the stem just below the buds under the ground, and kept in tin cans all winter. Some of the cans were closed and some left open and, although they moulded very badly, quite a number of imagoes emerged between May 17th and some time during the first week of June. In most of these cases the imagoes emerged from the stem where cut off at the top; but in nature they emerge at the side of the stalk a few inches above the ground and the exuviae is left sticking out of the hole about two thirds of its length.

A search for material on June 1, 1907, resulted in finding a few pupae and larvae in shaded places while the majority of the stems showed that the imagoes had emerged some time previous. Several of the infested stalks were sent to Prof. C. H. Fernald at Amherst, Mass., at his request, and the moths that appeared from them were pronounced to be the species, under discussion. Bred specimens of this moth were first identified for me by Mr. W. D. Kearfott of Montclair, N. J., to whom I am indebted for the determination of nearly all of my Micro Lepidoptera.

Full Grown Larva.

Length at rest 8 mm., in motion 9½ mm. These measurements were taken from larva described, but others were found measuring one or two millimeters more than this.

General color creamy white, tinged to varying degree with red, especially on

last few segments, so that some larvae have no trace of this color, and others are decidedly red. From specimens examined it appears that young larvae have this color more marked than even the reddest full grown ones. Entire body, with exception of head, second segment on dorsum, anal shield and numerous prominences scattered over the body, has a peculiar rough appearance due to minute spine-bearing elevations distinguishable only under the microscope, and it is also faintly shining. These elevations, minus the spines and less prominent, may be found on all the smooth portions by careful microscopic examination.

Head strongly bilobed, light castaneous, smooth, shining, with a few scattered light brown hairs; bordered posteriorly by narrow dark brown band, which ends just back of ocelli in an irregular brown spot. Lateral edges of clypeus and two longitudinal sutures on under side of head very dark brown. Vase shaped light central area on ventral side of head, with the base posterior, space between this and the two above mentioned sutures dark brown. First segment of antennae pale, rest same color as head with segments beyond second bearing several light brown hairs. Ocelli six in number, pale, placed on a dark brown spot. Labrum with central lighter band which varies from pale at upper end to light brown at lower, and with all outside this band dark brown. Mandibles dark brown, with almost black tips. Other mouth parts pale with their tips and lateral edges of labium darker.

Body strongly segmented, second segment anterior three-fourths light brown with numerous small darker areas, wrinkled, shiny; third wider, fourth and fifth narrower than third, sixth wider again and remainder slightly decreasing in diameter to posterior end of body. Third and fourth segments each with two transverse sinuate wrinkles over whole of dorsum, and one small one each side of median line in front. Fifth to twelfth segments with one wrinkle like large ones in other segments. Anal shield smooth, shining, tinged with yellowish brown and possessing a slight central depression. Numerous small, smooth, shining prominences are present on body located as follows: on dorsum there are two parallel rows each side of median line on fifth to twelfth segments inclusive, the four on each segment being placed so as to form a trapezoid on segments five to eight, and a square on nine to twelve. These two rows are replaced by double prominences on segments three, four and thirteen. Just below these rows there is a partial row with prominences placed on segments two, three, four and thirteen.

Below this and close to stigmata there is another row on segments three to eleven inclusive and two more, evidently belonging to this row, on twelfth and thirteenth segments on a level with stigmata, that on the twelfth being placed just in front of the stigma. Another row set close to the stigmata below on segments two to thirteen

inclusive, those on segments three and four being out of line and on a level with the stigmata. Just above line of legs there is another row on segments two to thirteen inclusive and on ventral side, segments five, six, eleven, twelve and thirteen have each four prominences placed in a transverse line.

First prominence of the partial row on the side bears three hairs, each of the others of this row and all the double prominences mentioned bear two hairs and a single hair is borne by every other prominence. All hairs are light brown in color.

In addition to above mentioned hairs, there are three each side of median line on line with dorsal prominences, a circle broken in front around depression on anal shield and several on each leg, all of about the same color, but all those on under side of body are much shorter and somewhat lighter.

Under side of body uniform creamy white, true legs same color, with tips darker. Claws and vertical line on inside of first segment of each leg dark brown. Prolegs on segments seven to ten inclusive and thirteen same color as body with terminal ring of light brown hooks on first four pairs and half ring of same hooks on last pair.